5th BACSA INTERNATIONAL CONFERENCE
"SERICULTURE FOR MULTI PRODUCTS – NEW PROSPECTS FOR DEVELOPMENT"
SERIPRODEV

April 11th – 15th 2011

Bucharest, Romania

P R O C E E D I N G S

Black, Caspian Seas and Central Asia Silk Association (BACSA)

Institute for Bioengineering, Biotechnology and Environmental Protection – S.C. BIOING S.A.
Bucharest, Romania

Bucharest

2011

TABLE OF CONTENTS

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"SERICULTURE FOR MULTI PRODUCTS – NEW PROSPECTS FOR DEVELOPMENT"
SERIPRODEV

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PROGRAMME

Organizing committee:

President: Assoc. Prof. Dr. P. Tzenov, President of BACSA and Director of Sericulture and Agriculture Experiment Station, Vratza, Bulgaria.

Vice-president: Dr. Maria Ichim, General Manager, Institute for Bioengineering, Biotechnology and Environmental Protection, Bucharest, Romania.

Secretary: Mr. L. Ichim, Institute for Bioengineering, Biotechnology and Environmental Protection, Bucharest, Romania.

Members:

Dr. E. Kipriotis, BACSA vice president for Europe and director of Agricultural Research Station, Komotini, Greece.

Dr. Kh. Khomidy, BACSA vice president for Central Asia and Caucasus and international consultant in Rwanda

Prof. Dr. of Sc. D. Grekov, Rector, Agricultural University, Plovdiv, Bulgaria.

Dr. B. Abbasov, Leading scientist, Sericulture Research Institute, Gandja, Azerbaijan.

Dr. S. Cappellozza, responsible person for scientific programmes, CRA - Unità di ricerca di Api-bachicoltura, sede di Padova, Italy.

Prof. Dr. N. Stepanishvili, Director, Sericulture Research Institute, Tbilisi, Georgia.

Mr. U. Ramseier, President, Swiss silk association, Switzerland.

Mr. Dormush Yilmaz, Kozabirlik sericultural cooperative, Bursa, Turkey.

Scientific committee

Dr. E. Kipriotis
Dr. S. Cappellozza
Prof. Dr. Y. Miao
Dr. K. Etebary
Assoc. Prof. Dr. P. Tzenov

Venue and Dates:

Bucharest, Romania, Ambasador Hotel, April 11th – 15th 2011.

11 April

Arrival of the participants, check in at Ambasador Hotel and registration.

12 April

9:00 – 10:00 Registration.

10:00 – 10:10 Opening by Assoc. Prof. Dr. P. Tzenov, President of BACSA.

10:10 – 10:20 Welcoming speech by Dr. Maria Ichim, Director of S.C. BIOING S.A., Bucharest, Romania.

I. Plenary papers session: Chairman Dr. P. Tzenov

10:20 – 10:45 Plenary paper: "*Black, Caspian Seas and Central Asia Silk Association (BACSA) activities for revival and development of sericulture in Europe and Central Asia*" by Assoc. Prof. Dr. P. Tzenov, President of BACSA.

10:45 – 11:00 Plenary paper: "*Recent Trend of the Functional Sericulture Development in Korea*" by Mr. Dong-Chul Park, president of Korea Sericulture Association.

11:00 – 11:15 Plenary paper: "*International Cooperation Strategy in Sericulture Development Project*" by Dr. Kee-Wook Sohn, Director of International Cooperation, Korea Sericulture Association.

11:15 – 11:30 Coffee break.

11:30 – 12:00 Plenary paper: "*The research trend for improving added-value of sericulture*" by Dr. Kang-Sun Ryu, Department of Agricultural Biology, NIAST, RDA, Korea.

II. Country reports session: Chairman Dr. E. Kipriotis

12:00 – 12:30 ***Country reports session 1:***

- **Greece**: "*The Recent Sericultural Situation in Greece, Aspects and Prospects*" by Dr. E. Kipriotis.
- **Turkey**: *"The sericulture in Turkey" by Mr. Dormush Yilmaz*
- **Switzerland**: "*Silk Production in Switzerland – an Innovative Project of Swiss Farmers and the Swiss Textile Industry*" by Mr. Ueli Ramseier.

12:30 – 13:00 Visit the sericulture exhibition.

13:00 – 14:00 Lunch.

14:00 – 14:45 ***Country reports session 2.***

- **Poland**: "*Sericulture in Poland*" by Dr. Małgorzata Łochyńska.
- **Bulgaria**: "*Recent sericulture situation in Bulgaria*" by Prof. Dr. D. Grekov and Assoc. Prof. Dr. P. Tzenov.
- **Indonesia**: "*Reviving Sericulture in Indonesia*" by Mr. Peter McNair.

14:45 – 15:00 Coffee break.

Scientific – technical reports session – Oral presentations: Chairman Dr. S. Cappellozza

15:00 – 16:00 ***Scientific – technical reports session 1 – Oral presentations:***

- *"Phylogenetic differentiation of silkworm (Bombyx mori L.) strains with different origin raised in Bulgaria"* by Teodora Staykaova at al.
- "*Influence of lead on organo - mineral composition of roots, leaves and fruits of Morus sp*." by Maria Ichim, Adriana Visan.
- "*Polish white mulberry (Morus alba L.) and new directions of its utilization*" by Małgorzata Łochyńska.
- *"Organic sericulture for bivoltine production"* by B. N. Susheelamma

16:00 – 16:15 Coffee break.

16:15 – 17:00 ***Scientific – technical reports session 2 – Oral presentations:***

- "*The effect of methoprene treatment on Vth instar silkworm larvae reared on artificial diet*" by Silvia Cappellozza, Alessio Saviane.
- "*National bio-resource project in Japan and development of cryopreservation methods for silkworm resources*" by Yutaka Banno.
- "Silk *presentation processing activities in place Palotai, Bihor, Romania*" by Rosika Georgeta Costache.
- *"Why sericulture?"* by Li Long

20:00 Welcoming Dinner.

13 April

Technical and study tour visit to Râmnicu Vâlcea sericulture area (250 km from Bucharest) and cultural program - Cozia Monastery and the Hermitage Island, located in the middle of the Olt River (lunch and dinner during the tour).

14 April

9:00 – 10:00 ***Scientific – technical reports session – poster presentations:*** **Chairman Assoc. Prof. Dr. T. Staykova**

10:00 – 10:30 Coffee break.

10:30 – 12:30 Round table discussion: Chairman Assoc. Prof. Dr. P. Tzenov

12:30 – 13:00 BACSA Executive committee meeting.

13:00 – 14:00 Lunch.

14:00 – 18:30 Bucharest city tour.

20:00 Farewell dinner.

15 April Departure.

Opening Speech

By

Assoc. Prof. Dr. Panomir Tzenov, President, Black, Caspian Seas and Central Asia Silk Association (BACSA)

5th BACSA INTERNATIONAL CONFERENCE "SERICULTURE FOR MULTI PRODUCTS – NEW PROSPECTS FOR DEVELOPMENT" *SERIPRODEV*

Bucharest, Romania

April 11th – 15th 2011

Good Morning Ladies and Gentlemen,

I would like to take this opportunity to express a cordial welcome to all of you attending this conference. In order to be present here today, you all must have put aside other important work and daily tasks. I believe, this conference will provide opportunities to discuss common issues, seek solutions, share experiences and information, conceive ideas for future directions, and exchange resources and technologies, while getting to know each other for future collaboration in production and trade chains of sericulture products.

Why this international conference topic is a sericulture for multi products? Since unfortunately the silkworm rearing activity is recently decreasing at both international and national levels, it is necessary a diversification of exploitation methods for mulberry plantations and silkworm production. The sericulture implies significant quantities of secondary and waste products. In order to ensure a profitable sericulture activity, it is necessary to process these secondary and waste products in order to obtain biologically active substances with important uses in pharmaceutical, cosmetic, paper and cellulose, and organic agricultural and food industries. By applying, some modern methods for processing the secondary and waste products from sericulture, additional incomes that will even double or triple the incomes obtained from the main activity could be created.

However the introduction of a multi products sericulture may face various problems, like for example:

- Lack of tradition and experience in the scientifically based processing the products from sericulture for non - textiles;
- Not sufficient research made on the subject;
- Lack of enough industrial technologies for sericulture products non-textile processing;
- The present sericulture subsidizing systems in most of countries do not consider a non – textile production. For example the European system for giving subsidies to the sericultural farmers requires producing obligatory not less than 20 kg of fresh cocoons from one box of eggs. In the case that the farmers sell silkworm larvae instead of cocoons they can not get any EU subsidy.

- The mulberry and silkworm breeding priorities need to be re-directed in order to meet the requirements of the products use for non – textile purposes.

In the countries, having comparatively high costs of production in order to survive in sericulture business, producers should not make cheap products with low quality to compete for the prices, but to produce more sophisticated products, natural and environmental friendly which satisfy consumers even though they are more expensive.

So, the development of sericultural products use for non – textile purposes direction may be considered as an alternative way to solve partly the problem with the decline of silk production and the efficient utilization of the existing sericultural human capacity, research and production facilities.

Finally, I wish you all pleasant stay in Bucharest and a successful participation in this conference to the end, and a safe trip back to your home countries, bringing with you some work plans and business ideas to be put into practice for further development of sericulture for multi products in your respective countries and for further progressive international collaboration.

I would like thank very much to Dr Maria Ichim, Mr. Liviu Ichim and the staff of BIOING for their tremendous efforts in organizing the present conference.

I also extend the greetings and wishes to all conference participants and BACSA Executive committee members from Prof. Dr Hoo Zoo Lea, ex – FAO senior officer who is one of the founders of BACSA and presently our Executive committee member.

Thank you very much again for coming this far and for listening.

Welcoming speech

by

Dr. Maria Ichim, Director of S.C. BIOING S.A., Bucharest, Romania

Distinguished Guests,
Dear Colleagues,
Ladies and Gentlemen,

It is my great pleasure and joy to wish you a "welcome" to the 5th International Conference on Sericulture and BACS (Black Caspian Seas and Central Asia Silk Association)
Welcome to Romania a country whose area is 237500 km ² and 22.5 million which is home to hospitable people, following the events of December 1989, went on the road to development. It pays to come to Romania because here you can see the tradition alive, almost untouched villages who live their daily life simple, beautiful peaks of snow-covered mountains, deep valleys, caves, the famous Danube delta and the sea. Welcome to a country half way between the Atlantic and the Urals. A direct link on the Danube, between the North Sea and Black Sea. Romania is a country of contrasts and paradoxes: the country of Constantin Brancusi, Eugene Ionesco, Emil Cioran, Mircea Eliade, and Nadia Comaneci, but also of Dracula and Nicolae Ceausescu. Traditional Romania is a vast museum of ancient heritage, still alive even if only through its famous painted churches and monasteries, through folklore and medieval castles in the Carpathian Mountains. Modern Romania can be represented by the Parliament Palace, the subway network in Bucharest or Western style of life adopted by the population. The capital, Bucharest, is its largest city and sixth city in the EU population (1.9 million inhabitants).
International Conference on Sericulture was imposed in the scientific world by addressing systemic problems, in order to identify a path towards a new economic model to follow in the EU and Asia.
It is a great pleasure for us Romanians in the country, neighboring countries and all continents, to meet in a spirit of solidarity based on ethics of science.
I kept for the end to express my gratitude for those who have tried to prepare papers to be presented at the conference dedicated to issues that are currently a global concern
I will say welcome and wish you success in carrying out the work of the conference and a pleasant stay in Romania.

5th BACSA INTERNATIONAL CONFERENCE
"SERICULTURE FOR MULTI PRODUCTS – NEW PROSPECTS FOR DEVELOPMENT"
SERIPRODEV

Bucharest, Romania

April 11th – 15th 2011

LIST OF PARTICPANTS

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AGENDA

For

the expert panelists' discussions within the 5th BACSA international conference "Sericulture for multi products – new prospects for development" – SERIPRODEV, Bucharest, Romania, 11 to 15 April 2011.

14 April 2011, Bucharest, Romania

10.30 – 12.30 **Round table discussions**

Chairperson: Dr P. Tzenov

Facilitator: Dr M. Ichim

Opening: Dr P. Tzenov

Topics of the discussion:

- Problems, issues and development strategies of sericulture non – textile products.
- Problems, issues and development strategies of organic sericulture.
- Problems, issues and development strategies of silkworm and mulberry germplasm preservation, conservation, utilization and exchange.
- Problems, issues and development strategies of cocoon production revival in Europe.

- Possible influences of silk production decline in China on the world sericultural industry.
- Major challenges facing the new entrants in the sericultural industries development.
- Necessary measures for improving the international cooperation in sericulture at regional and global level.
- Recommendations for promotion of a multi products sericulture.
- Suggestions for conference decisions, recommendations and follow ups.

Plenary papers

BLACK, CASPIAN SEAS AND CENTRAL ASIA SILK ASSOCIATION (BACSA) ACTIVITIES FOR REVIVAL AND DEVELOPMENT OF SERICULTURE IN EUROPE AND CENTRAL ASIA

By

Assoc. Prof. Dr. P. Tzenov, President

Black, Caspian Seas and Central Asia Silk Association (BACSA);
e-mail: panomir@yahoo.com

(ORAL PRESENTATION)

The Black, Caspian Seas and Central Asia Silk Association (BACSA) was initiated at the "International Workshop on Revival and Promotion of Sericultural Industries and Small Enterprise Development in the Black, Caspian Seas and Central Asia Region", organized by the AGST, Food and Agriculture Organization of the UN (FAO) in collaboration with the Government of Republic of Uzbekistan from 11 to 15 April 2005 in Tashkent, Uzbekistan. This workshop identified major constraints which might had caused the critical situation and recommended immediate follow-up activities which would be required for trouble shooting and also to produce executable long-term development strategies, while laying the foundation for restoration and further progress of sericultural industries in the region.
The initiation and conducting of all those sericultural new regional activities has been realized with the great personal contribution of Dr Hoo Zoo Lea, FAO Senior officer and Dr Jong Sung Lim, FAO consultant.
For its already 6 years existence BACSA has been performing many different activities, targeted in regional sericultural industries revival and development, which could be summarized in the following main directions:

- Strengthening of BACSA as an institution.

- By the financial and technical help of the FAO the proceedings of the first regional workshop, held in Tashkent were prepared, printed out and distributed to over 50 persons from more than 25 countries;
- A special logo of the association was created;
- A BACSA membership form was prepared and sent to a number of institutes/persons involved in sericulture development in different countries, later on it was uploaded at the BACSA web site;
- In May 2005 a brief information about the workshop, held in Tashkent purposes, activities and results was provided to the International Sericultural Commission (ISC), Lyon, France and uploaded at the ISC' web site;
- A text book in English entitled "Sericulture training manual", having a special emphasis on the European and Central Asian sericultural industries specificities was compiled, printed on the expense of Greek government and distributed to over 25 countries along with the Tashkent workshop proceedings;
- The official registration of BACSA as a legal entity in Bulgaria took place in April 2006. BACSA was registered as a legal entity with statutory office in Vratza, Bulgaria;
- BACSA web site functioning: The web site (www.bacsa-silk.org) was created in May 2006 and since that time it has been well maintained, regularly updated and all the important news and useful information are uploaded on it. According to many BACSA members and other people engaged in sericultural industry development the web site is really very informative and useful;
- The local national governments have been informed about the 2nd, 3rd and 4th BACSA executive meetings results, decisions and follow ups. Most of BACSA's national coordinators managed to get official "Letters of support" on behalf of their governments about principle support to the regional project for sericulture revival and development.
- When established in 2005 BACSA included 9 countries - Azerbaijan, Bulgaria, Georgia, Greece, Kazakhstan, Tajikistan, Turkey, Ukraine and Uzbekistan. Later on gradually, BACSA attracted for membership 6 new countries from the region – Albania, Armenia, Iran, Poland, Romania and Switzerland so that currently the association includes 15 countries and also has 64 personal members and 4 institutional members. The personal members from countries, out of BACSA region are mostly from India (43), but also from China (2), Egypt (2), Korea (1), Ghana (1), Syria (1) and Indonesia (1). Presently BACSA has 19 members of the Executive committee from 16 different countries. The Executive committee members have been updated in the end of 2009.
- Letters of support to the local leading sericulture institutions have been sent officially to the Governments of Georgia and Ukraine, personal recommendations were provided to several personal BACSA members as international experts, reviews of scientific monographs and doctoral dissertations were also done and sent to the national institutions respective.
- Popularization of BACSA activities in the world. In all the visits of BACSA president to China, Japan, India, and Thailand the association was well presented and the possibilities for international collaboration explored.

- Organizing international meetings.

Five international conferences, workshops and BACSA executive committee meetings have been organized and held from 2005 to 2011.

From 6 to 10 March 2006, at Bursa, Turkey BACSA in collaboration with FAO and the Kozabirlic sericultural cooperative, Bursa, Turkey as a hosting institution organized the second BACSA executive meeting along with an "International Workshop on Silk Handicrafts Cottage Industries and Silk Enterprises Development in Africa, Europe, Central Asia and the Near East" where 62 delegates from 22 countries took part at the meeting.
The 3rd BACSA executive meeting was held from 18 to 20 September 2007 at Vratza, Bulgaria together with the international conference "Sericulture Challenges in the 21st Century" (Serichal 2007), organized by BACSA, FAO and the Sericulture Experiment Station in Vratza, Bulgaria as a hosting institution. 41 delegates from 14 countries took part at this meeting.
The 4th BACSA meeting was held on 5th November 2008 at Athens, Greece during the 21st Congress of the International Sericultural Commission.
The first Balkan workshop on "Possibilities for Using Silkworm and Mulberry for Non-Textile Purposes" was held in Plovdiv, Bulgaria from 23 – 26 September 2008. The Agricultural university of Plovdiv, Bulgaria was hosting the meeting in collaboration with the Sericulture Experiment Station, Vratza, the Bioengineering, Biotechnology and Environment Protection Institute – BIOING S. A, Bucharest, Romania and the BACSA.
The 5th BACSA international conference "Sericulture for multi products – new prospects for development" – SERIPRODEV is held in Bucharest, Romania from 11 to 15 April 2011. The S.C.BIOING SA, Bucharest – Romania is hosting the meeting in collaboration with the BACSA.
The proceedings of all those meetings have been uploaded at the BACSA web site and/or printed and distributed by post to many countries.

- Development of regional sericulture projects and looking for donors.

- **Project proposals, submitted to FAO**

The regional project proposal: "**Improvement of Income-Generation Options Based on Revival of Sericultural Industries and Promotion of Small Silk Enterprise Development in Eastern Europe and Central Asia".** This project proposal was submitted officially to the FAO through the governments of Azerbaijan, Armenia, Bulgaria, Romania, Tajikistan and Uzbekistan. Then the FAO several times returned it back to BACSA with their recommendations for necessary revision. In spite of the several revisions, and re-submissions (the last one was in 2008) the project proposal had finally been cancelled for financing by the FAO.
By the same time, following the decisions taken at the second BACSA executive meeting a Project Concept Note, summarizing the project content was prepared and submitted to many potential donors in May 2006 (UNDP, (ADA, CIDA, DCI, DEZA, DFID, FAO, GTZ, IFAD, ITC, UNCTAD, JICA, KOICA, NORAD, SIDA, UNIDO, USAID, EBRD and the World bank). The purpose of this initial approach to the prospective donors was just establishing on-line status and letting them know about BACSA and its activities in operating a field project in the region and seeking for funds. However no any donor manifested any interest in funding the project.

Therefore it may be concluded that until now BACSA failed in finding funding for the regional project for sericulture revival and development. However after 2008 we have continued our efforts in seeking for the FAO support to some of BACSA member countries rather than to the whole region. **As results of these efforts two FAO TCP facility projects in Albania and Georgia were approved and financed.** Those are TCP/ALB 3101 "Revival and Development of Sericulture in Albania", implemented in 2008 – 2009 and

TCP/GEO/3201 "Sericulture sector study in Georgia", implemented in 2009 – 2010. Both two projects had a financing of about 40,000 US$/project and aimed mostly based on the real situation of the sericulture sector in each country to prepare bigger sericulture development projects, ready for donor search.

The regional project "Comparative studies of silkworm hybrids performance for sericultural enterprise development in Black, Caspian seas and Central Asia region"
This project was implemented in 2006 and 2007, partly supported by the FAO. From the testing as a general conclusion appeared that the silkworm hybrids, produced in BACSA member countries have comparatively high hatchability, pupation rate, cocoon weight, shell weight and fresh cocoon yield by one box of silkworm eggs, but compared with the Japanese and Korean hybrids the local hybrids manifested lower cocoon shell ratio and raw silk percentage. Based on this conclusion we recommended to the BACSA member countries research institutions to direct their efforts towards improvement the silk productivity of the hybrids, by the same time preserving their comparatively high survivability and cocoon yield. As results recently in Bulgaria, Romania and Azerbaijan several new silkworm hybrids, manifesting silk productivity, comparable with those of the Japanese hybrids were created.

In the end of 2008 two proposals were prepared by Dr P. Tzenov and Dr S. Cappellozza (Italy) and on behalf of BACSA submitted to FAO, seeking for support to the regional sericulture germplasm maintenance, evaluation, exchange and utilization. Those were "**REGIONAL SERICULTURE GERMPLASM RESOURCES NETWORK FOR AFRICA, MIDDLE EAST, CENTRAL ASIA AND EUROPE"** and Regional workshop on **"Utilization of mulberry and silkworm genetic resources for sericultural enterprises development in Africa, Middle East, Central Asia and Europe".** Both two proposals haven't received enough FAO interest for possible support.

- **Project proposals, submitted to the European commission**

The project proposal **"Support for unlocking and developing the research potential of silkworm breeding and innovative management techniques in Bulgaria, Greece and Romania, targeting to the small silk enterprise development"** was submitted in 2007 for possible financing by the EU **FP 7 "Capacities" Programme, Part 4 Research Potential, Activity Area: ''Unlocking and developing the research potential in the EU's convergence regions and outermost regions''**
The main target of this project was improving the capacities of the involved in sericulture selected centres in Bulgaria, Greece and Romania by know-how and experience transfer to the scientific and technical personnel from the participating other EU countries (France and Italy). The planned project budget was around **800,000 EUR** for two years. The project was prepared by the efforts of researchers from Bulgaria, Greece, France, Italy and Romania and finally revised, generalized and submitted in the end of April 2007 to FP_7 programme by the project coordinator Dr E. Kipriotis from Greece. Unfortunately the project was not approved for financing.

The project proposal **SERINNOV– SEE EoI/B/481/1.3/X "Sericulture and silk products in South East Europe - stepping from the tradition to innovation and strengthening the economic profile of respective regions"** was submitted to South East Europe Programme – 2nd Call for proposals in 2009. The project proposal included 5 countries, namely Albania, Bulgaria, Greece, Italy and Romania and the draft was mainly prepared by Dr E. Kipriotis. Unfortunately, the project proposal was not approved.

Project FP7 – KBBE – 2009 – 3 – 5 "EXPLOITATION OF THE HEAVY METAL MOVEMENT AND REMOVAL PATHWAYS AND MECHANISMS IN THE MULBERRY – SILKWORM CHAIN FOR THE ESTABLISHMENT OF MODEL APPLICATIONS FOR FURTHER PRACTICAL USE IN BIO-REMEDIATION OF CONTAMINATED SOILS. SOILBIOREMEDIATION"
The project proposal included 5 countries, namely Bulgaria, Greece, Italy and Romania. The draft was mainly prepared by Dr E. Kipriotis. The project proposal was not approved.

- Working out national sericulture development plans. The BACSA national coordinators in Armenia, Azerbaijan, Bulgaria, Tajikistan and Uzbekistan with the assistance of BACSA president prepared sericulture national development plans for the period 2007 – 2015. The plans were disposed to the attention of the government of each country, submitted to the FAO and uploaded at the BACSA web site. The national development plans availability was required by the FAO for the regional project proposal.

- Strengthening the relationships and cooperation in sericulture between the BACSA member countries and other countries as well.

- **Bilateral agreements for cooperation.**

During the period several bilateral agreements for scientific and technical cooperation were signed between the Sericulture Experiment Station, Vratza, Bulgaria and the Uzbek Sericulture Research Institute, Tashkent, the Commercial Society "Sericarom", Bucharest, Romania, Institute of Bioengineering, Biotechnology and Environmental Protection - S.C. BIOING S.A**.,** Bucharest, Institute of Genetic Resources, Kyushu University, Japan, Institute of sericulture, Zhedjiyang National University, Hangzhow, China, the Council of Research and Experiments in Agriculture, Apiculture and Sericulture Unit of Bologna, Padua seat, Italy, Sericulture research institute, Kharkov, Ukraine. Through these agreements for bilateral cooperation mulberry and silkworm germplasm resources, new scientific and technical information, visits of researchers are exchanged, joint participation in research projects is realized etc., therefore the making of agreements and their implementation is very useful for all the participating parties.

- **Selling and buying sericultural products**

BACSA makes all the efforts to establish connections between the producers, sellers and buyers of different sericultural products such as mulberry saplings, silkworm eggs, dry cocoons, raw silk, silk yarn, fabrics and garment. We perform these activities through regular updating of the sub-page "sell/buy information" on the BACSA web site as well as responding in time to all the enquiries from possible sellers and buyers, getting the people together and giving chance to exhibit their sericultural products by organizing international workshops, conferences etc.
We could make the following suggestions and recommendations for future BACSA activities:
- Organizing BACSA international conferences and Executive meetings once per each 2 – 3 years in different member countries from the region;
- Regular informing the national governments about the BACSA executive meetings results, decisions and follow ups;
- Responding to different enquiries, concerning the sericultural industries in the region;

- Maintaining, regular updating and all the important news and useful information uploading on the BACSA web site;
- Attracting more European and Central Asian countries as BACSA members;
- Regular updating of the BACSA Executive committee members, based on their personal efficiency;
- Supporting the sericultural institutions and specialists in the BACSA member countries by providing when necessary letters of support, personal recommendations, reviews of scientific monographs and doctoral dissertations etc.
- Popularization of BACSA activities in the world through participation at international conferences and meetings;
- Development of regional sericulture projects and looking for donors;
- Promoting making bilateral and multilateral agreements for cooperation, giving a special emphasis on exploring the opportunities for financing from the national governments;
- Establishing connections between the producers, sellers and buyers of different sericultural products through regular updating of the BACSA web site, responding in time to all the enquiries from possible sellers and buyers, organizing international workshops, conferences, exhibitions etc.

BACSA Executive committee would appreciate any useful ideas and suggestions about our activities.

Recent Trend of the Functional Sericulture Development in Korea

Park, Dong-Chul
President of Korea Sericultural Association

The distinguished delegations from all the sericulture developing countries,
Ladies and gentlemen!!

As the president of Korea Sericultural Association, I am very glad to be here with all of you to exchange the recent information on sericulture development of each country and to discuss on the global development of sericulture industry.

On this occasion, I'd like to introduce the recent trend of sericulture development in Korea. The sericulture sector in Korea, with long history for more than three thousand years, greatly contributed to raising rural income during the past three decades of 1960's, 70's and 1980,s. This development was achieved mainly by the strong support from Korean government to raise rural income by producing cocoons and to earn foreign currency by exporting raw silk.

In 1970's, as a result of strong support from the national sericulture development plan, Korea used to be one the most important sericulture countries in the world, with about 500 thousand cocoon producers, about 83,000 ha of mulberry fields and rearing of more than one million boxes of silkworm eggs, producing about 42,000 tons of fresh cocoons in 1976. The annual export of sericulture products reached about 500 million US dollar during 1980's and 1990's.

However, Korea sericulture had difficult times during the last two decades, due to high labour cost caused by rapid industrialisation and the radical change in agriculture structure, lacking competitiveness in the international silk market. The traditional way of sericulture to produce and sell cocoons could not give enough income for the sericulture farmers to maintain sericulture activities, letting them to abandon the production of cocoons.

During the 20 years between 1976 and 1995, the number of sericulture farmers remained only 1%, the area of mulberry fields and the silkworm rearing reduced to 3% and 2%, respectively. Most surprisingly, in the year of 2010 about 1,200 silkworm rearing farmers reared more than 15,000 boxes of silkworms, but there was almost no production of cocoons and raw silk in Korea.

Since 1995, Korean sericulture researchers tried to diversify the sericulture products to enhance the agricultural income for the sericulture farmers. Based on the medicinal archives written in 1610 by Heo Joon, a famous Korean medical scientist, the medicinal uses of sericulture products were experimented, utilizing the mulberry tree, fruits and leaves, and the silkworm larvae, pupae and moths including cocoon layer and silk.

Thus the sericulture industry in Korea switched the main products from producing the wearing silk materials to supplying functional food supplements for human medicinal use. Since 1995, the main sericulture product has been silkworm powder used for reducing human blood glucose level, which was finally approved legally by Korea Food & Drug Administration in 2009, as a functional food helpful to control human diabetes.

Apart from the silkworm powder, various functional sericulture products came to practical use for enhancing human health conditions, such as 'Dongchunghacho' (silkworm cordyceps) grown on the silkworm pupae, which is effective to cure cancer and strengthen the immune system, including silk cosmetics, silk soap, silk toothpaste and ice cream of mulberry leaves.

The new functional sericulture products enable the Korean sericulture farmers to have more income than the traditional cocoon production, and the number of sericulture farmers and the area of mulberry fields could have been maintained in recent years.

Another peculiar trend in sericulture industry of Korea is a sudden increase of production of mulberry fruits with participation of about 5,700 mulberry farmers, producing about 5,600 tons of mulberry fruits in 1,670 hectares of mulberry gardens. It is estimated that the annual agricultural income earned by the functional sericulture food including mulberry fruits was more than 40 million US dollars in 2010.

Since the silkworm can provide us not only with silk to wear but with various other products useful for human health, I believe that it is necessary to have a joint research work between Korea and other countries. This will help to seek the diversified utilization of sericulture products, searching for new demand and market of sericulture. The research of functional sericulture will contribute in enhancing human health as well as increasing the sericulture farmers' income.

In order to support the new paradigm of the functional sericulture in Korea, the Ministry for Food, Agriculture, Forestry and Fisheries is planning a new sericulture support policy through the investigation on the economic impacts of new sericulture, after Korean National Assembly enacted a new law to backup the functional sericulture industry in April, 2009.

According to the recent information from 'Japanese Silk Report', the cocoon production in China in the year of 2008-9 reduced dramatically, which will eventually bring the upward fluctuation of international price of raw silk in coming years. As Korea imports annually about 200 million dollars of raw silk and silk products, Korean silk companies are keenly concerned about the silk price in the international market. Regarding this situation, a deep and sincere discussion should be followed in this forum, I hope.

In the spring of 2012, the Korea Sericulture Association will hold 'World Exhibition of Functional Sericulture Products'. The detailed time schedule will be informed later. Your interest and participation will be highly appreciated.

Lastly, I'd like to express my sincere thanks to Dr Tzenov and the organizing staff of BACSA for their successful organization of this conference and for providing us valuable opportunities to discuss on the mutual interest in developing sericulture industry of the world.

Thank you very much for your kind attention.

12 April 2011

Park, Dong-Chul
President of Korea Sericultural Association

INTERNATIONAL COOPERATION STRATEGY IN SERICULTURE DEVELOPMENT PROJECT

By

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(ORAL PRESENTATION)

The international price of cocoon and raw silk is highly dependent on the policy and production of sericulture in China, which produces more than three quarters of world silk production. The decrease in cocoon and raw silk production in China in 2008-9 naturally provoked a sudden raise of international raw silk price in 2010. The cocoon purchasing price in China raised to almost five US$/kg last year to induce domestic cocoon production will make the international raw silk price maintain in higher level or unstable.

South Korea joined OECD/DAC (Development Assistance Committee) in January 2010 and the Korean Government has decided to increase the fund for Official Development Assistance (ODA) from 0.1% of Gross National Income (GNI) to 0.25% by 2015. South Korea is the unique country in the world that changed its status from an Aid Recipient Country, receiving a total of 12.7 billion dollars of international aid during 1945-1990, to a Donor Country after World War II in so short period of time.

In agriculture sector, Korea has achieved the 'Green Revolution' of self-supplying rice in 1975, and 'White Revolution' which made it possible to supply fresh vegetables all year round using greenhouses. The sericulture sector also played an important role for early economic development during 1960s and 1980s.

With my experience in international cooperation in sericulture development, the following aspects are considered in preparing sericulture project proposal to submit to KOICA (Korea International Cooperation Agency), official organization, established in 1991 to manage grant aid and technical cooperation programs.

1. Visit the home page of KOICA (www.koica.go.kr/English) to understand the policies and strategies of Korean grant aid.
2. KOICA concerns about 1) how to make a success in sericulture development project and 2) the capacity of Korean Sericulture Experts when the domestic sericulture sector is shrinking.
3. It is necessary to cooperate between recipient country and Korean experts in preparing project proposal for results-oriented project development.
4. A group of retired sericulture experts in Korea is preparing to organize a NGO "Korean Service for International Sericulture Development", for which foreign participants also invited.
5. As the Korea Sericulture Association is to host 'World Exhibition of Functional Sericulture Products' in May, 2012, an In-country sericulture training program is proposed.

Many other subjects may be discussed for enhancement of international cooperation in sericulture development.

SERICULTURE IN INDIA: STRENGTHENING RURAL BASE TO EXPAND GLOBAL REACH

By

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India is developing as potential silk producing country among many silk producing countries of the globe. Unlike China, Brazil or some of the South-East Asian countries Silk industry in India presents a captivating but complex picture of a highly decentralized industry , with a large number of players in different areas like food –plant cultivation , rearing of silkworms, reeling, twisting . spinning, post yarn processing which includes dyeing, weaving, printing, finishing, trading and export. India has many advantages as India is credited for at least four distinctions in the world of silk. Indians are the largest consumers of silk, second largest producer of silk ,largest importers of mulberry silk and producer of all four commercially exploited silk in the world viz, mulberry, tasar , eri and muga. The golden muga silk is unique to India in the
world. The silk production in India has increased from 4000 tonnes in 1980 to more than 18000 tonnes in 2010.More than 53000
thousand villages of India are involved in silk production. The size of Indian silk industry is about US $ 2.76 billion. In India under mulberry category multivoltine and bivoltine silk is produced. Traditionally silk producing peninsular India falls in the tropical belt; multivoltine sericulture has been the one that is extensively practiced in India. On the other hand, scientists of Central silk Board in collaboration with Japan International Cooperation agency (JICA) have achieved breakthrough in developing many productive bivoltine breeds .In India Non-mulberry silks are the products of rich, salubrious climate and nourishing vegetation. Despite its aura of luxury and wealth, the production of silk is a highly employment –oriented, low capital intensity activity ideal suited to the conditions of a human –resource abundant economy.
Keywords: Sericulture, silk

THE RESEARCH TREND FOR IMPROVING ADDED VALUE OF SERICULTURE

By

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(ORAL PRESENTATION)

Korean silkworm industry, which had been focusing on silk production previously, switched its market for supplying food supplements and raw materials for medicine in 1995.
Since then, it has been producing products, such as silkworm powder for reducing blood glucose levels, silkworm dongchunghacho (cordyceps), which is effective to cure cancer and strengthen the immune system, silk cosmetics, silk soap, silk toothpaste and ice cream of mulberry leaf that encourage the growth of silkworm farmers to some 4,000 in the nation. Silkworm is an insect of which every part can be used for all different purposes.
Therefore, the sericulture to produce only silk fabric now has been changed into the functional sericulture of a new paradigm to relieve the patients as well as to increase the farmers' income dramatically. Those functional sericulture will be further developed and finally reborn into a real biotechnology-based sericulture in the future.
In addition, silver agriculture and experiential studies with sericulture are going to attract the retirees in cities and help children's studies.

Country reports

THE RECENT SERICULTURAL SITUATION IN GREECE, ASPECTS AND PROSPECTS

By

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(ORAL PRESENTATION)

THE SERICULTURE IN TURKEY

By

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(ORAL PRESENTATION)

To: Assoc. Prof. Z.Tzenov, PhD
President of the BACSA
Director of Sericulture and Agriculture Experiment Station
Vratza, Bulgaria

Brief Information about Current State of Sericulture in Georgia

by G.Nikoleishvili

This is to inform you that the situation in Georgia sericulture is still complex. Respective authorities do almost nothing (if any) to overcome crisis in the branch.

Practically, production of cocoon (grain) is stopped, sericulture industry is ruined and there are other problems too. Although we still hope that 2010 year will become a year of beginning of withdrawal of the branch from the crisis. This hope of ours is based on the fact that in the country there is a perfect environment and rich traditions for the development of sericulture. Majority of the population is interested in the production of silk cocoon, there are businessmen who desire to invest their resources in this branch. But it requires further work with them. The work is in progress for drawing a perspective plan for the development of sericulture together with other branches of national economy etc.

It should be emphasized that in the last years the Orthodox Church of Georgia, which enjoys great authority, showed its interest to a deed of the revival of sericulture. Some non-governmental organizations express their interest too. These are:

a) "Foundation for Revival of Agriculture"
b) "Union of Young Agrarians"
c) Eparchies of Sachkhere-Chiatura, Telavi-Akhmeta, Khoni-Terjola (each eparchy covers 2-3 administrative regions) and other organizations.

On the base of the insistent demands I rendered them support free. I acquainted them with the plans of development of the branch according to stages and realization of these plans has been commenced already. Thus, for example, first stage of preparation works was started in Sachkhere-Chiatura eparchy - at about 3 thousand mulberry saplings were planted, registration-recording of the existing mulberry plantation was performed, number of sericulturists was defined, the needed grain volume was determined etc. These works were funded from the resources of the eparchies and the above-referred foundation. The second-stage works are now in progress.

"Union of Young Agrarians" has found the source of funding and it carries out analogous works. Relevant works are implemented at other organizations too.

Scientific Research Institute of Sericulture leads serious activity. Collection land plots and industrial plantations were organized, definite achievements were attained in the sphere of sericulture selection etc.

Two mulberry varieties (Aisi, Phazisi) from the grant-funded works were submitted to relevant organization for zoning, 5 demonstration land plots were organized by the provision of vertical zoning. Selected mulberry trees were planted on the territories adjoining the farms of 15 farmers in Adjarian Autonomous Republic and mulberry leaf stored from these plants in spring is used in sericulture, while "mulberry leaf flour" prepared from the coarse leaf stored in autumn – will be used in livestock-growing. Some monographs and a number of scientific papers were printed. Instructions were developed and approved for mulberry varieties testing by the

provision of modern demands. Ministry of Agriculture of Georgia approved these instructions.

Mr. Panomir, the above-referred measures are implemented mainly at the initiative and under the leadership of amateurs of the branch, but if this attitude is lost in Georgia the revival of the branch will be hampered for a long time. To somehow prevent it, we need only 3-4 kg high-grade grain, two average-capacity cocoon drying and two cocoon-reeling machines. Currently we have the resources to pay for the above stated material and devices.

Therefore, we ask you, if possible, to advise us and provide us with the address of the organization, which would sell to us 3-4 kg high-quality grain and the above-referred devices to us.

Thank you in advance for cooperation.

G. Nikoleishvili G. Nikoleishvili
Professor
Coordinator for FAO in Sericulture in Georgia

15.01.10

I, G.Japaridze, Scientific Secretary of Academy of Agrarian Sciences of Georgia, witness to the authenticity of signature of G.Nikoleishvili:

G.Japaridze Japaridze.

CONDITION OF SERICULTURE IN UKRAINE

By

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Today we can speak only about formal existence of sericulture's branch in Ukraine. For the last 2 years any of 18 sericultural farms have not engaged in manufacture of cocoons. These farms still have a state ownership on ground, debts on wages and are compelled to survive at the expense of cultivation of grain and other agricultural cultures. In spite of the fact that silkworm is referred to objects of animal industries supposing the grant on the part of the state (the amendment to the law from 2009), the real financing of sericultural branch on the part of the state still has not been occurred.. Nowadays the destroyed infrastructure of branch requires significant capital investments in maintenance of processing of cocoons, repairing of rearing buildings, caring of mulberry plantations. The sericultural farms could not realize it with our effort and the private business has not put the money in sericulture.

The state grant for reproduction of breeding herd's silkworm for 2009-2010 years has made about 4.000 €. But the financial conditions of many farms keep out to use even this opportunity to earn. Therefore for the last 2 years the cultivation of breeding cocoons has been engaging by the department of sericulture of National Scientific Center "Institute of Experimental and Clinical Veterinary Medicine" (new structure after reorganization of sericultural Institute UAAS). During this time we have made 12 kg breeding eggs of regional silkworm breeds, which has not remained claimed for industrial rearing of silkworm.

The financing of the scientific and technical sericultural program has been realizing since 2011 for the purposes of the program «Preservations of genetic resources of animals». The collection of genetic resources of silkworm totals of 122 breeds and has received the status of the National property of Ukraine. Nowadays the seven employees of the department of sericulture are engaged in the maintenance of the breeds' collection. The basic directions of researches consist of the methods' optimization of selection-breeding work with silkworm and using the DNA-markers for the genetic typing of breeds' collection. The last scientific development is:

- the new methodology of using the quantitative attributes in selection process has been offered;
- the computer's database of the genetic silkworm's resources has created using the means of Access 2003 (9.500 records, 1.500 photo);
- the computer program with use of the Visual Basic and the statistics' programs have been developed. The statistics' programs will be able to create the complex estimation of the silkworm's productivity.
- the researches of the polymorphism of microsatellite loci of the silkworm's breeds collection with the help of the ISSR-PCR analysis are still in progress.

SILK PRODUCTION IN SWITZERLAND – AN INNOVATIVE PROJECT OF SWISS FARMERS AND THE SWISS TEXTILE INDUSTRY

By

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(ORAL PRESENTATION)

Silk was for Switzerland a very important good. The first known silk production dates back to 1250, when in Zurich a flourishing silk production and manufacturer cottage industry has been established. It is reported, that in the year 1785, 300'000 mulberry trees were planted alone in the area of Lausanne. Before World War 1 the last cocoons were produced in the southern part
of Switzerland. After a break of 100 years, the project Swiss Silk aims at reintroducing the silk
production in Switzerland.
Aims:
-· The silk production in Switzerland shall be reintroduced.
-· Main aims are the creating of side income for Swiss farmers and at the same time strengthening the Swiss textile industry.
Project Characteristic:
-· Decentralised Production of Biovoltine Cocoons.
-· Centralised silk worm nursery, cocoon drying and silk reeling.
-· Manufacturer of Silk accessories such as ties and shawls by the Swiss textile industry.
-· Marketing by Swiss high end brands such as Weisbrod - Zürrer AG and Akris with as strong
emphasis on Swissness and ecology.
The market potential has been elaborated based on consumer research. From the 250 tons of raw silk manufactured in Switzerland annually, we estimate a potential of approximately 5%, which gives a potential of 10 tons raw silk per year. This would give a side income for 150 farmers, each with 1 hectare (10'000 square meter) of plantation (total 330'000 trees) The gross income for the farmers would be 3,2 million Swiss francs which will be used to pay their own labour (CHF 2,2 million) and depreciation. Additional income will be generated for silk reeling (CHF 1,8 million) and the selling of the pupae for fish feed. There are unfortunately no subsidies by the Swiss Government.

SERICULTURE IN POLAND

By

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(ORAL PRESENTATION)

- In 2004 mulberry silkworms breeding was moved from Żółwin to Poznań,
- preservative breeding,
- 44 Polish varieties of mulberry silkworms:
  - 30 Polish
  - 7 Romanian
  - 4 Georgian
  - 2 Chinese
  - 1 Japanese
- Plantation of the white mulberry (*Morus alba* L.) in Experimental Farm INF&MP in Petkowo,
- INF&MP is the one and the last institution in Poland with silkworms breeding.

Scope of work:

- Maintenance and broaden silkworms breeding,
- Obtain new industrial hybrids,
- Broaden white mulberry cultivation in Poland,
- Broaden plantation of the Polish mulberry „Żółwińska",
- Obtain an artificial diet for caterpillars,
- New ways of silk and mulberry utilization in Poland and other EU countries (medicine, cosmetic and pharmaceutical industry).

In 2010 was signed a cooperation agreement with Sericultural Research Institue of Liaoning, China.
Exchange, evaluation and utilization of silkworms germplasm between China and Poland.
Exchange information on methods of silkworms breeding and cultivation of white mulberry.

RECENT SERICULTURE SITUATION IN BULGARIA

By

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(ORAL PRESENTATION)

The organizations and companies dealing with sericulture development in Bulgaria are the Sericulture Experiment Station in Vratza, Agricultural University in Plovdiv, Thracian University in Stara Zagora, and the private companies Bulsilkmill Ltd, Sofia, Bulgarian Association of the Silk Producers, Processors and Exporters, Sofia and Textile cluster Bulgarian silk J.S.C., Sofia. Research with the silkworms and also teaching is also performed at the Forestry University, Agronomy faculty, Sofia and Plovdiv University.

In the last two years the Sericulture Experiment Station (SES) in Vratza has continued and expanded its activities in conducting complex researches in sericulture, national silkworm and mulberry germplasm maintenance, production of mulberry saplings, silkworm eggs, dry cocoons, raw silk and ready silk commodities. The station appears to be one of the biggest mulberry sapling and silkworm egg producer in Europe presently. SES – Vratza incubates the silkworm eggs and distributes to selected farmers newly hatched silkworm larvae. Upon the larval distribution, the station makes a contract with each farmer, taking the obligation to buy his cocoons produced. After cocoon harvesting the farmers bring them to the station where the staff makes their evaluation and the cocoons are purchased, based on their quality. During the last two years the fresh cocoon purchasing price has been 6 Euros per kg. The station uses about 70 % of the cocoons purchased for egg production and the rest are sold either as dry cocoons or processed to raw silk and silk commodities. SES – Vratza has also it's own mulberry plantations and silkworm rearing houses for cocoon production.

The company Bulsilkmill Ltd has a silk twisting plant with an annual capacity of about 30 t of raw silk. All the raw silk is imported, mostly from China and the ready product is exported to Italy.

Association of the Silk Producers, Processors and Exporters has ambitious plans for planting over 8000 ha mulberry plantations all over the country and starting a big cocoon and silk production, but so far the activities are restricted to negotiations with several municipalities for renting some land and buildings.

The company Textile cluster Bulgarian silk has been trying for several years to get a big loan in order to start sericulture development projects, but so far they do not have the necessary financial capacity to start a significant cocoon and silk production.

Due to the SES – Vratza efforts the sericulture has been included in 4 measures of the EU Programme for rural areas development, namely

- Professional training, informational activities and scientific knowledge dissemination;
- Establishment of farms by young farmers;
- Modernizing the agricultural farms;
- Semi-subsistence farms development.

SES – Vratza has won a project for training in sericulture though the first measure, so it is planned to train 120 farmers in the second half of this year. There are some projects financed through the measures for young farmers because the support, provided by this measure is as a grant, while in the Modernizing the agricultural farms measure only 50 % of the support is paid by the Pogramme as a grant. The sericulture farms are small and the owners are comparatively poor, so for them it is too difficult to get loan from the bank in order to cover all the investment costs and then after the project is completed to receive reimbursement of 50 % of the investment costs from the Programme. Even though the measure for Semi-subsistence farms provides 1500 Euros every year for totally 5 years as a grant the interest in this measure is still too low, not only among the sericulture farmers, but among the agriculture farmers in general.

Unfortunately the direct subsidies system presently adopted in Bulgaria does not benefit the cocoon producers. The reason is that national subsidies for the cocoon producers have not been authorized by EU, so the EU subsidy per ha can not be utilized because most of the sericulture farmers use single trees, planted along the streets of the villages and the share of

plantations is very small. On the other hand the EU and national subsidies, paid per ha of land are not beneficial for all the agriculture intensive crop branches, including the sericulture as well.

The main constraints facing the sericulture development in Bulgaria are as follows:

- The cocoon producers expect to have a fresh cocoon purchasing price not less than about 6 Euros/kg, but the raw silk price at the world market is still too low, thus not allowing to pay a so high price for the fresh cocoons and as a consequence the Bulsilkmill Ltd company still prefers to import raw silk from China than to organize a local production of cocoons/raw silk in Bulgaria;
- The European Union subsidy in amount of 134 Euros/box of silkworm eggs reared is still not allowed for Bulgaria even though the Bulgarian Government sent an official request to the EC for solving this problem.

If the trend for raw silk price increase continues and the problem with getting the EU subsidy of 134 Euros per box of eggs reared is solved most probably it would lead to a gradual sericulture revival and development in Bulgaria. We consider that the present constraints facing the sericulture development in Bulgaria are mainly economical and organizational, but not technical. All the other preconditions are available, such as own rich sericulture germplasm, own production of high quality silkworm eggs and mulberry saplings of highly productive varieties, system for silkworm larvae distribution, cocoon purchasing and initial processing, resulting in a good cocoon quality control, over 1.3 million single mulberry trees and over 10,000 households with tradition and experience in rearing of silkworms, rearing houses and equipment available in the country.

In conclusion Bulgaria may be considered as a European country, having a good potential for sericulture development thus it could be created either as a promising high quality raw silk source or as a silk processor and trader.

REVIVING SERICULTURE IN INDONESIA

By

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(ORAL PRESENTATION)

Abstract: Silk as we all know is a highly valued natural fibre, which is increasing in demand around the world. With the reduction of supply from China, opportunities exist for other countries to fill the demand gap.

This paper looks at the silkworm and mulberry plant resources available in Indonesia, what is required to develop improved silkworm varieties, methods to enable year-round availability of silkworms and mulberry leaves, improved mulberry harvesting, creating an export culture for the sericulture products and potential funding for an integrated sericulture industry.

Indonesia is an agrarian based society. Sericulture is an agro-based industry, the end product of which is silk. It provides scope for a generation of quick sustainable economic growth. Being a land-based intensive occupation, it provides maximum employment opportunities especially for rural people. Such requirements and outcomes make Indonesia one of – it not

the - best-placed country in the world to capitalize on an efficient, sustainable export oriented sericulture industry.

Acknowledgements

Appreciation should be addressed to the staff at the Department of Planning and the Department of Forestry and Plantation – Republic of Indonesia - for their assistance, support and facilitating my research activities. I also wish to thank Mr Rainer Prakuso Tobing an Indonesian businessman whom without his help, my research would not have been complete and delivered as I desired.

A thank you also is extended to the Bupati and his staff, Local Government and especially the petani who allowed the efficient implementation of the research and provided the support needed to organize the research work.

Finally, thanks are due to everyone interviewed in Indonesia and particularly the farmers who extended their friendship and hospitality to make the research a pleasure to undertake - without their cooperation, this research would have not been possible.

Kind Regards

Peter D. McNair

Reviving Sericulture in Indonesia

The South East Asian Hub for Sericulture - Macro

Silk as we all know is a highly valued natural fibre which is increasing in demand around the world.
The opportunity for new/other products exists in Indonesia but first the industry must be re-established and made sustainable. This paper therefore looks at the background and the current silkworm practices in Indonesia, what is required to develop a sustainable industry which includes methods to enable year-round availability of silkworm seed and mulberry leaves, improved mulberry harvesting, creating an export culture for the sericulture products and potential funding for a coordinated integrated sericulture industry.
The worldwide demand for silk is increasing but production is decreasing and an opportunity exists for a number of countries and especially for Indonesia to use technical and commercial expertise to develop its own specialist silk industry.

Traditional silkworm rearing methods are manpower intensive and are considered a complementary activity of the traditional agricultural activities such as rice. Because of the traditional methods being employed - sericulture is mostly carried out in underdeveloped countries where manpower is cheap (China, India, Thailand, Vietnam). It is suggested that Indonesia falls into this category.

It has also been recognized by many world organizations including NGO’s that sericulture is a means of poverty alleviation in under developed countries. Sericulture provides an income for small land holders and farmers (petani) as well as additional income for local people directly involved in the breeding, rearing and reeling associated with the sericulture industry. Sericulture is an excellent industry for local women to be involved.

Indonesia consists of approximately 17,500 islands (6000 inhabited) and is an agrarian based society - with sericulture being an agro-based industry – the two are complimentary.

Sericulture provides scope for quick sustainable economic growth, a poverty alleviation industry if managed correctly and using foresight the industry is sustainable. Being a labour-based intensive industry, it provides maximum employment opportunities especially for rural people and especially for women. The requirements for a sericulture industry and the outcomes make Indonesia one of – it not the – best placed country in the world to capitalize on an efficient, sustainable export oriented sericulture industry. In Indonesia, mulberry plants grow vigorously and labour costs are relatively low with labour plentiful – a plus for sericulture to be successful.

Figure 1 Republic of Indonesia

Silk was introduced to Java around 1720 by then governor general of the Dutch East Indies, Hendrick Zwaardecroon, who also dabbled in coffee and spices.
Indonesia's early silk production was a failure. But traditional methods eventually overcame the failures and the industry has continued until the present day.
Many attempts to create a sustainable silk industry in Indonesia have failed due to lack of funds, poor leadership/management, poor mulberry stock, poor quality eggs, disease, lack of knowledge and the lack of desire to create a sustainable export industry. Indonesia like many countries finds sericulture to be a sideline industry that offers a means for people to increase income and provide work for women but only when they have other means of income. It is possible with the proper leadership and management for Indonesia to create a highly sophisticated sericultural industry – this is viable outcome.

China produces about 75% of the world's raw silk. India produces about 15% and Korea and Turkmenistan produce just fewer than 5% each. Approximately 30 other countries produce commercial silk. However, it is difficult to compete with China in the international silk market and it is suggested that Indonesia should aim at satisfying some of its own silk needs first and then produce silk to supply niche export markets.
Several countries have state sponsored sericultural research institutes and approximately 2000 strains of mulberry silkworm have been developed. Indonesia does not have this type of research facility.

Indonesia at the present only provides ad hoc interest to the industry and there is currently little appetite for a modern sericulture industry and its growth. Notwithstanding some areas within the Department of Planning are attempting to pull together a strategy for the future of the industry but it needs a "champion" to deliver change. It is hoped this paper will invigorate this appetite, produce the champion and lead to a sustainable modern industry. The future could include the production of amino acids for example from the cocoons to be used in cosmetics.

The Dutch as mentioned brought the technology for silk cultivation to Indonesia around 1720. Since that time sericulture has been carried out by petani in rural areas but very little has changed in the methodology employed. Over the years a number of programs and players have entered the industry but these have been short lived as the desire for a quick profit always overruled a strategy to create a sustainable industry where all the players are paid a fair price for their outputs.
Never the less, Indonesian environmental conditions are very suitable for the development of sericulture; this includes both silkworm rearing and mulberry plant cultivation.
Silkworms (*Bombyx mori*) and mulberry plants (*Morus spp.*) were widespread in Indonesia with little development work being undertaken on these resources until the present. As matter of interest the mulberry plants (8,066 Ha in 1999) has steadily decreased (less than 4,900 Ha in 2009) with only 600 Ha of mulberry available now in Java as petani (farmers) move into other value crops.

The first step in reviving sericulture in Indonesia is actually twofold –

- first - getting the interest of the petani again and demonstrating they can make a living in the industry and
- second - get Government to recognise the benefits and support the sericulture industry and have a strategy for growth and sustainability for the industry.

This second step must include the sourcing of suitable funding for downstream (rearing, reeling and twisting) and upstream (mulberry) activities. Funding one stream without the other will be futile. Once this second step has been implemented then it would be time to establish processes to increase production and create world best practice for the industry in Indonesia. Co-operation and collaboration with Organisations such as **The Black, Caspian Seas and Central Asia Silk Association (BACSA)** and support from the FAO and IFC will assist in advancing the sericulture industry in Indonesia and lessons learned by others to promote sericulture production will assist the industry in Indonesia.

For mulberry production we need to determine the best conditions under which to grow mulberry plants and the most efficient and economical way to harvest them. In tropical areas such as Indonesia mulberry can be harvested up to 8 times per year (average 6 times per year) with mulberry plants having continued growth but if not managed the leaves become tough and dry in the dry season. Techniques[1] have been developed to overcome this dry season unavailability of suitable mulberry leaves such as:

- Refrigeration of fresh mulberry leaves in sealed plastic bags and
- Artificial diets. The artificial diets contain about 30% mulberry leaves to which can be added bean powder, yeast, sucrose, cellulose, agar and water. Blocks of this diet

[1] **Silk Production in Australia - A report for the Rural Industries Research and Development Corporation** RIRDC Publication No 05/145 Nov. 2005 Pg.vi

can be stored in less space than mulberry leaves and could be kept refrigerated until needed.

Both refrigerated leaves and the artificial diet have been used to successfully maintain larval development during autumn and winter in experiments in Australia.

Additionally for Indonesia the petani require training in cultivation, fertilizing and maintenance of mulberry plants. Modern horticulture methods can be employed with suitable training. With training mulberry leaf output will increase.

For example - Twenty kilograms of raw silk per hectare can be produced from rain fed unfertilised mulberry plants using inferior silkworms; whereas up to 120 – 130 kg of raw silk per hectare can be produced using a better variety of mulberry for the particular region using good cultivation techniques , fertilizers and a good silkworm breed.

Harvesting in Indonesia is by picking leaves by hand or chopping branches using crude hand tools – the use of machinery is very rarely used and for mulberry leaf harvesting this is adequate as an abundance of labour is available. Efficient cultivation and maintenance of the plants though must be introduced and developed. Indonesia must introduce intensive cultural operations such as application of fertilisers, irrigation systems, breeding of mulberry and variety selection, training in pruning and regulation methods, and finally harvesting methods to ensure the right leaves are harvested for the correct instar.

The quality of the mulberry leaf fed to the instar is reflected in the quality of the silk produced. It is important to produce quality leaves to feed the silkworm. The quality of the leaf is a direct result of prudent agronomic management of the mulberry plant. A complete agronomic package of variety selection, planting techniques, nutrient management, water application, pest and disease control measures, and harvesting techniques ensures high yield and good quality mulberry leaf. Training and ongoing education and research is required for Indonesian conditions.

The current Indonesian silkworm seed produces poor quality cocoons and in turn low silk productivity and quality. The introduction of suitable silkworm seed for higher productivity is essential for a sustainable, viable commercial Indonesian sericulture industry. Extensive studies have been carried out over the years to review existing seed for commercial purposes, and to develop new races through a breeding program, for improved silk productivity, adaptability to local environments and disease resistance/tolerance capabilities. But such reviews have rarely been put into practice and have never been continued. The importation and improvement of silkworm eggs for higher productivity are necessary for running a profitable sericulture industry. Also the number of silkworm grainage should be increased and methods to improve egg quality must be achieved. Current silk seed comes from one major source and is of low quality.

For the Industry some specific objectives should be:

- Expanding and improving mulberry tree cultivation in the local environment,
- Introducing new techniques and methods in silkworm breeding to improve the production in quantity and quality terms,
- Reducing poverty among petani by improving the industry that makes additional income that leads to stabilization in the rural areas,

- Reduction in the use of chemicals (fertilizers-pesticides) as the mulberry tree doesn't need a lot of chemicals or introduce organic fertilizers that can be used instead.
- Improving and creating additional opportunities for women in rural areas since silkworm activities and the silk yarn industry offer employment to women.
- Introduce micro financing to support petani in the industry and
- Suitable financing to establish a sustainable private enterprise

Regarding the specific target groups:

- Increase the number of men and women silkworm breeders or willing breeders by making the industry cost effective and
- Educate both men and women willing to process silkworm products from cocoon through to weaving natural silk threads.

Over riding requisite

Everybody in the selected areas has the right to participate in the industry and gain access to the micro funding with priority being considered for those petani already working in silkworm breeding or in natural silk processing and willing to contribute to the overall objectives.

World Silk Production

The major silk-producing countries of the world today are, China, India, DPR Korea, Turkmenistan, Brazil, Uzbekistan, Thailand, Vietnam, Kyrgyzstan, Japan, Iran, Tajikistan, and Romania. Indonesia with all its potential does not rate among world silk producers and exporters.

Indonesian Resources

Indonesia has an ideal climate and topography for sericulture. For example a mulberry/sericulture plant can be located in Java at an altitude of 520 to 700 meters above sea level or more. Topographically, plains represents the most part of the area (43,73%), followed by slopes (about 23,75%), corrugated land (about 20%), and mountainous (21,82%). The land structure: brown latosol constitutes 40% of the total land, gray alluvial 35%, brown andosol 15%, and regosol 10% - ideal for mulberry.

The annual temperature ranges from 10^0 to 27^0 C. During the rainy season, rainfall ranges from 281 to 349 mm, reaching its peak in December and January. During the dry season, rainfall is between 86 to 219 mm reaching its lowest level in July and August.

In my example area, there are 78.153 people, 38.596 being males and 39.557 females, who inhabit the region. Most of the population (46.490 people) belong to the productive group (15 – 64 years old), 27946 pre-productive (below 15 years old), and 3.717 non-productive (over 65 years old).
The example area was selected for the research due to the altitude, range of the rainfall, air humidity, land condition and other aspects that have met the requirements for a sustainable sericulture industry. But it must be stressed that Indonesia has many such regions.

Another aspect considered when choosing an area for sericulture is the condition of supporting facilities such as roads, power, water and communications infrastructure and its relatively open access to other locations, and most importantly is the availability of human resources and high level of interest of the farmers (petani).

In my example the total potential area for natural silk development is approximately 20,712 Ha, and approximately 7,921 Ha of the area is available for mulberry cultivation. Some years back approximately 13,575 Ha had been cultivated, but interest has waned and the mulberry plants were replaced by other crops and the silk industry has continued to decline. All the pillars to revive the industry still exist. The prospect of natural silk development in the area is wide open for further development. Leadership and funding is required.

Java – The Potential Hub:

- There is sufficient land resource which is suitable for agribusiness development for natural silk. Most of the land is under the control of Perhutani ((Indonesian state forestry company).
- Mulberry cultivation and silk rearing is still traditional and semi intensive. This presents an excellent opportunity to develop;
- Small industry of textile and natural silk weaving exists;
- Textile industry of natural silk in Indonesia still lacks timely cocoon supply and the silk yarn is still imported at high cost but the desire to succeed is evident;
- The few existing silk farmers participate in a local cooperative and want to develop the agribusiness of natural silk;

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Until now, the constraints faced by people to develop the silk business in Indonesia are as follows:

- There is no co-ordinated strategy for the industry addressing sericulture “end to end”
- There is minimum infrastructure
- Capital is limited
- The quality of natural silk eggs and small silk worms has to be obtained from other districts at high prices and are of poor quality and delivery is ad hoc;
- Cocoon supply for weaving industry is low; and
- Natural silk is not the main business in the region because of current lack of supply, high costs caused by middlemen and little infrastructure or support to grow the industry.

To improve the performance of a national natural silk industry (sutra alam) in Java Indonesia a collaboration/partnership between an entrepreneur(s), investor(s), local and federal government, NGO’s and local people is needed to develop the industry and with technology create a world ‘best of class’ industry that many countries would be proud of. The development of mulberry cultivation and silkworm rearing is an environmentally sound business as well as supporting water and air conservation, reforestation and rehabilitation and provides excellent employment opportunities for the local people especially women.

Mr Tobing (an Indonesian Businessman) and I commissioned a feasibility study to review the financial and economic benefits of the silk industry in Indonesia in 1998.
The result at that time showed excellent benefits not only for the proposed industry and company but for Indonesia as a Nation. Those benefits still stand as of today.
We have planned a winning formula to take advantage of exporting high quality raw silk products with the design of a fully integrated sericulture facility.

The feasibility analysis we commissioned confirmed that this business is feasible to implement. The feasibility analysis indicated that:

- A company will incur a loss at the beginning of investment year 1. On the first year after investment (year 2) and onwards, the company will gain a net profit.
- Pay back period should be 7 - 8 years. This means that the capital that is invested by a company or investor can be repaid in 7 - 8 years.
- The ROI exceeds 23%

According to our feasibility analysis, the empowerment of an integrated facility in cooperation with the petani utilizing a small business model (refer Appendix 2) will have excellent outcomes. Other Requirements needed are:

- Full support from Department of Planning, Industry and Forestry and Plantation to provide licensing and other requirements,
- Encouragement and support from the Government of Indonesia and local regions and from other institutions in order to participate actively to:
    - create Indonesia as a centre of natural silk agribusiness and agro industry in South East Asia;
    - increase the labour absorption; solve critical land and economic crisis.
    - increase the cocoon production to fill demand of raw material for the natural silk industry and decrease dependence of import supply.
    - increase export non gas and oil and
    - encourage the developing program of natural silk.

Our feasibility and research centred on central Java. The following map indicates this area used as an example in this paper.

Moriculture- Mulberry - Micro

The purpose of mulberry breeding is to develop a variety that is an efficient user of nutrients and water, has a high yield, high quality, adaptability to environment, is pest and disease resistant, and has a high return. These desirable traits are spread among many species and

varieties and repeated hybridisation is done to evolve a variety featuring most of the desired traits. Such research is scarce in Indonesia. Indonesia needs to commence a horticulture program with the collection of as many local and exotic varieties as possible and evaluate their characteristics to select those varieties suitable to the respective region and provide the best outcomes.
Rain fed or irrigation - Leaves from irrigated fields have more moisture, protein, and other nutrients than rain fed leaves. Silkworm reared on leaves from irrigated fields will show better health, and an increase in weight, cocoon weight, and shell weight. It is recognised that nitrogen is the most important element that contributes to the increase in leaf yield. Nitrogen increases vegetative growth and leaf number, size and weight.
A complete agronomic package of variety selection, planting techniques, nutrient management, water application, pest and disease control measures, and harvesting techniques ensures high yield and good quality mulberry leaf[2]. Training and education of the petani will achieve this.
The leaf yield harvest is dependent very much on the soil, weather condition, and management practices. In tropical regions such as Java the leaves are available all year round whereas in temperate regions only 2 - 3 harvests are obtained.

Superior mulberry varieties have been developed through breeding processes, which are efficient users of nutrients and water with high yields of quality leaves and with traits of environment adaptability and pest and disease resistance. Collaboration and cooperation between Indonesian research facilities and other nations is encouraged including Australia.

Silkworm seed production

One of the areas that require urgent improvement in Indonesia is silkworm seed production. Indonesia has poor quality and timeliness of eggs. At the micro-level, petani cannot improve their output and silk quality while they receive poor quality eggs. The petani will increase their cocoon production with the introduction of better quality silkworm eggs and this will lead to increased yields.
Management of seed production which includes transportation and incubation play an important role in the success of the sericulture industry. To produce quality seed, it is very important to adopt an efficient scientific methodology of egg production. As there is no definitive research centre in Indonesia, silkworm seed sold to the rearers is arbitrary and silkworm breeds adapted to Indonesian conditions do not exist.

Silkworm rearing

Indonesia uses traditional silkworm rearing methods with few changes over decades. There is a distinct lack of technical advice whenever serious problems arise and there is a lack of guidance and supervision during rearing of silkworm for the petani. In nearly all instances the farmer is left to his/her own devices.

Rearing space plays an important role in the success of a silkworm crop and improvement of cocoon quality. Overcrowding leads to unequal and insufficient consumption of leaf, unequal growth of worms, susceptibility to diseases and low cocoon yield. The importance of a wider rearing space has been studied for multivoltine silkworm rearing. Such practices need to be implemented.

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[2] Ming-FangFa *et al.* 1994

Low hatching percentage of silkworm eggs, high disease incidence of silkworms, low yield of quality cocoons, limited facilities for rearing, inadequate quantity of mulberry leaves and low quality mulberry leaves for rearing, are the problems faced by the petani in Indonesia. Lack of operational funds, rising costs of materials and labour, long time to recover investment, limited market of cocoons, low price and low grades of cocoons, are just some of the issues facing the industry.
The resultant outcomes produce poor quality cocoons and silk – what is needed is central control, an intergated facility, research facility and a sustainable strategy for the industry.

To enable petani to obtain high-quality raw silk (at least 3A grade) or better the following activities must be employed:

- Design rearing beds to meet the conditions for each rearing unit without overcrowding
- Identification of the best conditions for disinfection management of the rearing units
- Obtain high quality cocoons
- Training and ongoing education
- Increase the efficiency of rearing by 50 %
- Increase the number of annual cycles for up to 6 cycles by education with mulberry harvesting and leaf storage
- Establish a central research organization to disseminate data
- Establish an integrated sericulture facility to be used as a bench mark and produce good quality eggs.
- Increase employment (especially female employment), in cocoon rearing, reeling and within the raw silk processing fields. This is one of the main objectives for the Indonesian Government .
- Reduce poverty in the villages by introducing employment opportunities. This is also an Indonesian Government priority.

Marketing of cocoons / Marketing of raw silk

The success of the sericulture industry can come down to a proper and highly efficient marketing system which assures good prices to the petani. Efficient marketing helps in minimizing wide fluctuations in cocoon prices. It has been found that fluctuations are due to variations in cocoon quality, absence of quality control, intervention of middlemen and poor marketing facilities[3]. Women in the industry are preferred because of their nature, patience and hard work and hence they are employed in the mulberry fields or in silkworm rearing or weaving centre. However, the women's work has not always been recognized or rewarded.

[3] Development Planning and Project Cycle Analysis for Sericulture in Central Java Dissertation - Djeimy Kusnaman 2004.

The good work they do should be promoted and marketed. Though sericulture is lucrative by nature, it faces various problems in aspects of marketing. The problems faced by sericulturists in Indonesia mainly relate to insufficient financial support from government agencies, climatic hazards, wide fluctuations in cocoon prices and also, to some extent, inadequacy of extension services – research and training. Our research revealed problems like rearing sheds, stop start supply of cocoons, lack of awareness, low literacy level, poor infrastructure, etc. The availability of cocoons throughout the year can ensure the regular buyers in the market a better price. Training and education overcomes many of these problems. Various recommendations have been offered in this paper to pave the way for an improved sericulture industry, leading to an increase in foreign exchange earnings, and giving additional employment opportunities to the petani families, silk yarn reelers, silk weavers and others involved in the silk industry in Indonesia.
A proposed Silk Solution Centre (SSC) must be created and should establish then intensify its efforts to strengthen the marketing system in new areas to make the industry more viable. The SSC should establish standards and eliminate poor communication systems, establish a market infrastructure, agro-processing plants, marketing credit, a proper market organization, proper pricing, uniform grading and standardization of weights and measures.

Training

The Central Government, local government and NGO's have instituted many projects over the years which included training but still the problems within the industry exist. What is urgently needed is a central facility that can undertake specific research, produce and distribute silkworm news items and materials, conduct field trials, conduct training on all aspects of sericulture, transfer technology developed in the research facility to the field and improve the quality aspects of the sericulture industry

Such a facility could be run by private enterprise endorsed by the central government (Department of Planning or Forestry) on a "user pays" basis and subsidized to enable it to be sustainable and affordable to the petani. Training individuals, petani, reelers, etc in the technical and managerial aspects of sericulture is essential and a central facility can also be used for the production of disease-free seeds and for hybrid egg multiplication as well as for the required training.

Such a facility could be agreed and implemented immediately and seek support from such organizations as FAO / IFC.

Proposed Central Silk Organisation

For the development of silk industry in Indonesia a Silk Solution Centre (SSC), potentially a statutory body, should be established and functioning under the administrative control of the nominated Central Government Ministry.

The following are important functions the SSC should be accountable for:

- Promoting the development of silk industry by such measures as it thinks fit.
- Undertaking, assisting and encouraging scientific, technological and economic research.
- Devising means for improved methods of mulberry cultivation, silkworm rearing, developing and distributing healthy silkworm seeds with the support of private

industry, improving methods of silk reeling, improving the quality and production of raw silk.
- Collaborating with private enterprise to streamline processes including licences.
- Co-ordinating and supporting international collaboration with other international central sericulture centres.
- Improving the marketing of cocoons and raw silk.
- The collection and compilation of statistics.
- Advising the Govt. of Indonesia on all matters relating to the development of silk industry including import and export of raw silk and silk related products.

Conclusion

Global consumption for silk products is valued at over US $ 20 billion. The US and Europe are the major consumers accounting for around two-thirds of the global trade of about US $ 9 billion – US: 32%, Germany: 15% and UK: 11%. Improved global spending patterns coupled with wider variety of value added silk products are driving growth.

Manufacturing capacities for silk products are being shifted from Europe to destinations such as China and India. China being the largest producer (72%) of silk fabrics in the world is primarily focused on mass production. India is the second largest producer (17%), providing scope for an accelerated growth for the industry.
Indonesia stands to gain due to its lower cost of production, potentially skilled manpower, introduction of world class technology and increasing acceptance of its value added products. Sericulture is an important economic activity particularly for women, as women are most involved in the labour-intensive work of feeding silkworms, placing mature silkworms in frames and spinning yarn. Sericulture is also an income-generating activity for disadvantaged social groups, and a poverty alleviation strategy.

Indonesia must take action to establish a “world class” sericulture industry for export of silk products such as silk yarn, spun yarn, cocoons and related products such as amino acids. Such an industry should have world class, leading edge technology and expertise.

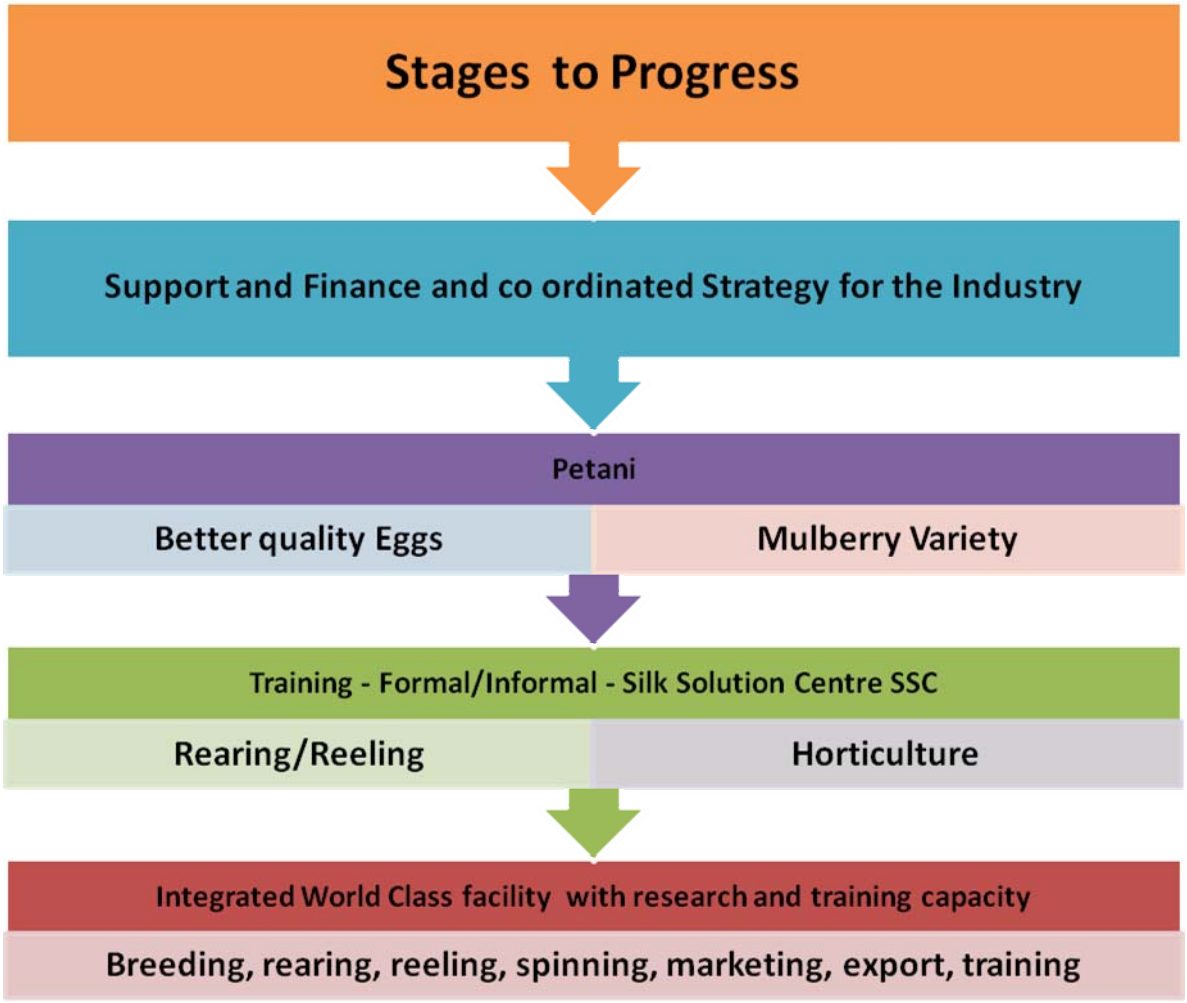
The recommendation is:

- To promote Java (Cianjur and/or Garut) as the hub of Indonesia’s natural silk business.
- To increase the production of export quality silk, and for Government to contribute to the promotion of national natural silk development.
- Revive the traditions and heritage in sericulture that are considered as a national and historical wealth, provide job opportunities for poor households and combating unemployment with a sustainable silk industry,
- With the support from regional and the central government, the success of the natural silk agribusiness model should be developed throughout Indonesia in all areas suitable for mulberry plants.
- A coordinated strategy to demonstrate Indonesia can produce sericulture products in an efficient and effective manner with minimal losses and good quality.

Quality and quantity of silkworms can be influenced from numerous variables, e.g. mulberry leaves, rearing shed, climate, and the petani themselves and to improve the industry in Indonesia means improving the environment for sericulture farming.

The final word: the most important thing is to improve the petani's human capital through training and support from a world class integrated facility.

Appendix 1. Strategy for way forward

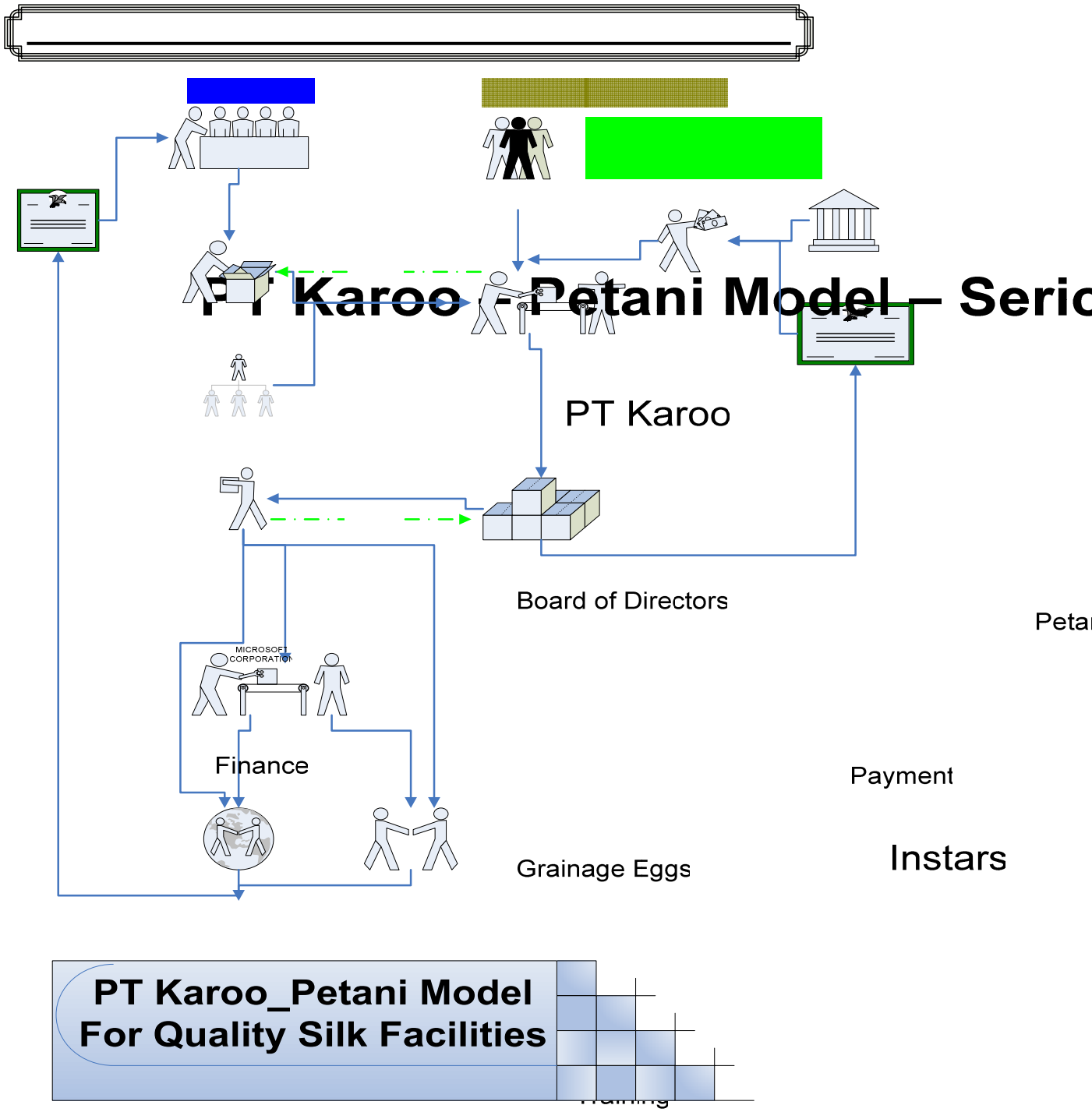


SSC (providing technical advice, training, silkworm eggs, funding)

NGOs (organizing groups, providing credit, technical advice, funding research)

Grassroots groups (producing silk products, selling to markets and more widely to increase income)

Appendix 2 - Suggested Model for Sustainability



SECTION 1

MORICULTURE AND NON-MULBERRY FOOD PLANTS FOR SERICIGENOUS INSECTS: SELECTION, PROPAGATION AND CULTIVATION

INFLUENCE OF LEAD ON ORGANO – MINERAL COMPOSITION OF ROOTS, LEAVES AND FRUITS OF MORUS SP.

By

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(ORAL PRESENTATION)

Abstract: The environment pollution with heavy metals (Pb, Hg, Co, Cu, Ni, Zn etc) is due mainly to the activity of humans.

High quantities of these metals can be toxic for all organisms. Still, some of them, called microelements, are necessary as components of enzymes or other proteins involved in major metabolic pathways.

The entry of heavy metals from the polluted environment in plants is influenced by different factors and stopped through several mechanisms. Their presence in plants can have effects on different physiological processes: photosynthesis, respiration, transpiration, cell membrane permeability, affecting even the whole process of plant growth (if they reach a certain concentration level).

Using heavy metal contaminated vegetal products in alimentation can have important effects on short or long terms, depending on the intensity and action period of the polluting factor.

This study is mainly aimed at highlighting the influence of physical-chemical properties of soil and their relationship with the Morus root and translocation of nutrients absorbed by roots in other vegetative and generative organs.

To achieve this objective were collected and analyzed samples of roots, leaves and fruit.

Keywords: Morus sp., lead, contamination, translocation

INTRODUCTION

Soil contamination with heavy metals became a serious problem both in the high affected industrial areas and in the agriculture. This problem obligatorily requires the remediation of polluted soils to maintain a healthy the environment.

Researches conducted on the pollution soil contamination with heavy metals showed several possibilities to remedy it at least partially, and extraction of these metals from the soil by cultivating plants with high capacity to absorb pollutants including Morus spp. is one of the most promising options.

As a result of pollution and high load of soil with heavy metals there is an increasing awareness about their mobility in soil plants absorb large quantities of these elements, and on the other hand, there is a deposited amount due to existing polluted air particles on leaves, shoots, etc.

Hyper-accumulating plants, which have ability to extract high quantities of metals from the soil and to concentrate them in their tissues while retaining metabolic functions, are considered primary candidates for phytoremediation processes. Plant species that are more efficient in the translocation of lead, should have rapid growth and produce large amounts of biomass while accumulating high concentrations of this metal pollutants.They should also be tolerant enough to grow in contaminated soils and to be resistant to the action of chelating agents.

The concept of using plants to clean up contaminated environments is not new. About 300 years ago, plants were proposed for use in the treatment of wastewater. At the end of the 19th century, *Thlaspi caerulescens* and *Viola calaminaria* were the first plant species documented to accumulate high levels of metals in leaves. In 1935, Byers reported that plants of the genus *Astragalus* were capable of accumulating up to 0.6 % selenium in dry shoot biomass. One decade later, Minguzzi and Vergnano identified plants able to accumulate up to 1% Ni in shoots. More recently, Rascio reported tolerance and high Zn accumulation in shoots of *Thlaspi caerulescens*. The idea of using plants to extract metals from contaminated soil was reintroduced and developed by Utsunamyia and Chaney (1983), and the first field trial on Zn and Cd phytoextraction was conducted in 1991 (Baker et al.). In the last decade, extensive research has been conducted to investigate the biology of metal phytoextraction. Despite significant success, our understanding of the plant mechanisms that allow metal extraction is still incomplete. In addition, relevant applied aspects, such as the effect of agronomic practices on metal removal by plants are largely unknown. It is conceivable that maturation of phytoextraction into a commercial technology will ultimately depend on the elucidation of plant mechanisms and on the application of adequate agronomic practices. Natural occurrence of plant species capable of accumulating extraordinarily high metal levels makes the investigation of this process particularly interesting.

Literature studies have led to the recognition of Morus spp. as essential components of ecosystem productivity and stability, being able to synthesize a remarkable diversity of secondary metabolites and to adjust their metabolic activities in response to abiotic stress factors. High biomass producing plant species, such as *Morus spp*., have potential for removing large amounts of trace metals by harvesting the aboveground biomass if sufficient metal concentrations in their biomass can be achieved.

Important characteristics of the Morus tree is its biomass production and its considerable longevity (50-100 years), in comparison to annual or biennial plant ecosystems of spontaneous and cultivated species, which are present in the same biotype.

Perennial nature of the Morus tree in time leads to the formation of an environment and ecosystem in which plants are influencing each other.

Romania is situated in an area favorable for moriculture; Morus spp. is cultivated everywhere except for the alpine and coniferous forest area.

MATERIALS AND METHODS

In order to highlight the influence of physico-chemical properties of the soil and their relationship both with Morus rooting system and translocation of nutrients absorbed by roots to other vegetative and generative organs (leaves, fruits, seeds, roots), samples of roots, leaves and fruit were collected and analyzed. The results were compared with the usual content provided by soil macro and micro data are presented in Table 1 and Table 2.

According to the Romanian System of Soil Classification due to natural conditions of climate, rocks, terrain and vegetation, red-brown soils, which due to human activity show different changes in the O-A and Bt horizons, which were typical of the investigated area.

Morus plantation establishment involved cleaning of the soil to a depth of 50 cm leading to the formation of the horizon Db; sloppy and frequently executed maintenance works determined the development of plantation above the horizon to horizon Ap.

Emphasizing the soil-plant relationship was conducted by collecting and analyzing a large number of samples of root material, leaves and fruit. In the samples was determined major nutrient content and heavy metal content. For major nutrients were determined concentrations of N-NO3-, N-total, P, S, K, Ca, Mg and heavy metals were determined concentrations of Zn, Cu, Fe, Mn, Pb, Ni, Cr, Co, and Cd.

Analyses were performed using standard methods for each of the indicators determined by specific laboratory equipment.

The test results were interpreted in comparison with the content of macro and micronutrients provided by the soil.

RESULTS AND DISCUSSION

Macroelements contained into roots, leaves and fruits are presented in Table 1, highlighting their mentioned translocation to plant vegetative organs. In Table 2 are the results of tests on heavy metals content in the samples.

Table No. 1. The content of major nutrients in the soil - plant

No. sample	Nature sample	Sampling horizon	N – NO_3 ppm	N total %	P %	S ppm	K %	Ca %	Mg %
1	Root	Ap	150	0.88	0.08	222	1.38	0.62	0.31
2	Root	Db	100	0.85	0.08	206	1.47	0.58	0.27
3	Root	Bt	180	0.88	0.08	222	1.47	0.53	0.30
4	Leaf	-	-	2.42	0.23	373	0.99	2.48	0.45
5	Reference values (leaf)	-	400**	3*	0.7	1.000 - 5.000	3	3	0.7
6	Fruits	-	150	1.51	0.15	155	3.39	0.80	0.29
7	Reference values	-	60**	3	0.7	1.000 - 5.000	3	3	0.7

	(fruits)								

(*) - simple values quoted from Davidescu -1963
(**) - values quoted from *Soil Studies Drafting Methodology* - ICPA – Bucharest - 1987

Table No 2. The content of heavy metals in soil– plant relation system

No sample	Sample nature	Soil horizon	Zn ppm	Cu ppm	Fe ppm	Mn ppm	Pb ppm	Ni ppm	Cr ppm	Co ppm	Cd ppm
1	Root	Ap	23.9	3.1	2282	69.3	3.8	10.0	3.0	1.67	0.23
2	Root	Db	15.0	2.2	1176	43.3	5.0	8.4	3.5	1.67	0.11
3	Root	Bt	18.3	2.1	1116	45.5	3.8	8.4	3.0	2.50	0.19
4	Leaf		24.2	3.9	-	30.5	9.1	10.6	2.1	10.0	0.43
5	Reference values*		20	7	400-1.300	30	3**	0.15-2.3	0.04-10	0.15	0.5**
6	Fruit sample 1 Fruit sample 2		20.8	2.9	271	22.4	**5.0** **0.93**	**7.2** **1.6**	1.5	**2.92** **0.09**	0.16
7	Reference values		50[x]	0.05[x]	400-1.300	30	3[x]	0.15-2.3	0.04-10	0.15	0.5[x]

(*) -simple values quoted from Davidescu - 1963
(**) - values quoted from *Soil Studies Drafting Methodology* - ICPA – Bucharest - 1987
([x]) - values quoted from the Ministry of Health Order no. 975/1998

The physico-chemical analysis showed which was the content organic matter and reflected the degree of mineralization of humus content and the C / N ratio. Thus, in the investigated horizons Ap and Db, the humus content is low as 2.59 % and 2.05 % respectively, while the C / N varies in the normal type of soil from 11.4 to 12.3; the Bt horizon showed a very low humus content which was1.02 % and C / N ratio indicated a sharp mineralization of organic matter with a value of 10.8.

Other natural soil properties that were investigated were:

- total cation exchange capacity denoted by TNH4 %, and degree of base saturation denoted by V%. It shows the following evolution:
- total cation exchange capacity increases from 12.92 % to 20.94 % from the worked horizon to the Bt horizon according to increasing of the clay content, because the organic matter decreases with depth. However, it is small compared with the state investigated the depth of natural soil;
- the degree of saturation in the base-profile varies, but remains within natural limits for this type of soil, the minimum value being 76.8 %.

Performed tests did not indicate significant changes in the analyzed indicators of soil properties except for the total cation exchange capacity which has fallen sharply, probably due to changes in bulk density. This indicator is particularly important in translocation of elements from soil to plants because it is related to the property called absorption capacity of soil (ACS).

Chemical analysis data on supply and translocation of trace elements into plants of Morus are presented in Table 2.

The research methodology of the soil-plant allows highlighting the process of translocation of mineral elements from soil to the Morus tissues.

In the root system normal values exceeded for the following considered nutrients: N-NO3, Nt, P, K, Ca, Mn, S, , Cr and Cd. In contrast to other, heavy metals exceeded for Pb, Ni and Co in the sample No. 1, Morus fruit, both whether they existed or they were not exceeding the normal content in the soil.

Thus, Pb and Ni continue their evolution from the soil to overcome the strong, recorded 5.0 ppm/100g values for fruit and 7.2 ppm Pb Ni, while Fe, Zn, Mn and Co exceed the normal values of plants in the soil even if they are within natural limits. To verify the results obtained in the first sample, Morus fruit were harvested from the same variety, but from another parcel and to review the contents of Pb, Ni and Co, values in obtaining the maximum permitted by applicable law and certain food products amounts of 0.93 ppm for Pb, 1.6 ppm for Ni and 0.09 ppm respectively for Co. Because the soil is slightly acidic the reaction between surface and deep neutral pH is a factor that induces increased mobility of elements, therefore content analysis resulted in the fact that Pb, Co and Ni in sample 2 (fruit) were below the maximum allowed.

One can appreciate that without a well-developed and complex adsorption of this Bt horizon (low permeability) moving elements in the soil solution is much easier and involves increasing absorption in the root. It is known that the area forms a root system with specific properties of the micro-ecosystem, called rhizosphere effect, where the root secretions (organic acids) and activity of microorganisms favors the solubilization of poorly soluble elements and their absorption into the root system in adition, biofertilizer with vesicular arbuscular mycorrhizae has a beneficial effect in stimulating microbiological activity in the rhizosphere.

Translocation of mineral elements in plants is influenced among others factors by their age and vegetation period (phenophase); it is well-known that during the life of trees, in the youth, transport is favored by high permeability of the plasma membrane of the cell wall;

therefore, an insufficient development changes both how the annual cycle proceeds and the direction of transport, such as growth in the shoots and leaves; in fact, essential mineral elements are directed to the vegetative organs.

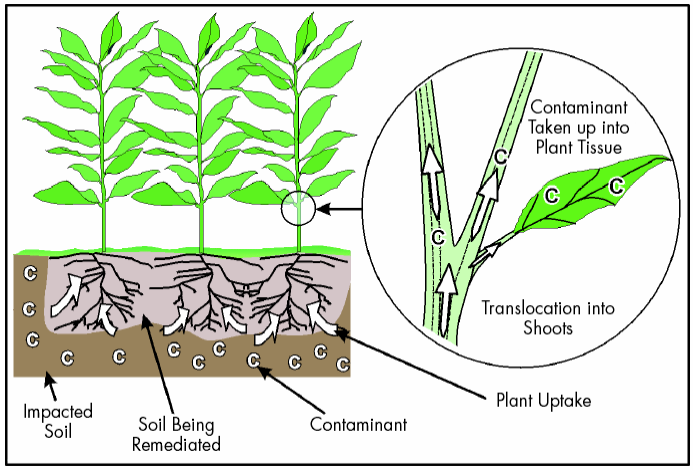

Fig . Translocation of contaminants

CONCLUSIONS

- In the category of heavy metals, a number of chemicals with high toxicity for living organisms is recorded. Toxic effect occurs when a threshold is overcome, below which some heavy metals may even be essential components of proteins involved in different metabolic pathways.
- To emphasize the soil-plant relationship samples of root, leaves and fruit were collected and analyzed and the results were compared with macro-and microelements content provided by soil. The root system did not make record normal values as limits were exceeded for the following considered elements: N-NO3, Nt, P, K, Ca, Mn, S, Cu, Cr and Cd. In contrast to other heavy metals limits were exceeded for Pb, Ni and Co in the fruits.
- Translocation of mineral elements in plants; it is influenced among others by their age and vegetation period (phenophase); it is well known that during the life of trees, in the youth, transport is favored by high permeability of the plasma membrane and cell wall development failure.
- Pb content in different organs of plants tends to decline in the following order: roots> leaves> stem> inflorescence> seeds.
- Crops raised on such lands will not be used for human food or animal, but only in order to decontaminate the soil.
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ROLE OF PARASITOIDS IN BIOLOGICAL CONTROL OF MULBERRY INSECT PESTS

By

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Mulberry pest management is very sensitive issue since pesticides lead serious problems like mortalities in silkworms, pest resistance, secondary pest outbreak, pest resurgence and environmental pollution. Therefore, safety and eco-friendly pest control programme is need of the day. Parasitoids like Braconids ,Ichneumonids , Chalcids, Trichogrammatids, etc., are widely used in biological control of insect pests. Hence, hoping the healthy environment and safety to silkworms parasitoid potential to control *Spilosoma obliqua*, *Spodoptera litura*, Syntomid caterpillars etc. have been discussed.
Keywords: Parasitoids, Biocontrol agents, Insect pests, Mulberry

PROBLEMS AND THEIR POSSIBLE SOLUTIONS IN THE CONTROL OF MULBERRY PYRALID *GLYPHODES PYLOALIS* WALKER

By

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Mulberry pyralid *Glyphodes pyloalis* Walker is the dangerous pest of the mulberry, progressing all over the world, affecting leaves of the mulberry. It reduces processes of the photosynthesis, their quality, weakens the plant and finally leads to its death. First of all this negatively affects on the nutritive base of sericulture.

Intensified control of the pest by chemical insecticides affects entomophages rather than target insect, causing greater propagation of mulberry pyralid and other pests and, as a whole, damages not only mulberry plantations, but also cotton growing due to territorial closeness of the cultures (Madyarov et al., 2007).

Mulberry pyralid larvae affected by entomophages and pathogens getting to silkworm larvae rearing rooms together with feed are the secondary factors of the pest's injuriousness. They can cause the additional losses in sericulture branch. For example bracon (*Bracon hebetor* Say) is a host both for mulberry pyralid and mulberry silkworm (Madyarov et al., 2003, Mirzaeva, Khamraev, 2006). Exactly likewise endogenic virus of mulberry pyralid is identical to virus of densonucleosis and to virus of infectious flasheria of mulberry silkworm (Watanabe et al., 1988). With growth of pest's population the risk of losses in sericulture due to these factors will increase.

In connection with abovementioned factors goal-directed and safe control of mulberry pyralid is complicated problem important not only theoretically, but also especially practically.

Recovery of former level of entomophages and the other agents of pest's biocontrol on sides of cotton fields with infected linear plantings of the mulberry is a solution of the problems in created situation. Practical measures in the control of mulberry pyralid must become the following: reduction of use of chemical insecticides affecting useful entomofauna, use of biocontrol agents produced on biofabrics (bracon and golden-eyed lacewings), as well as make the conditions for attraction and propagation of other active entomophages of mulberry pyralid: ladybirds, spiders, ants, hornets, wasps, others hymenopterans and some dipterans (Madyarov et al., 2008).

Weighty alternative to chemical insecticides can become baculovirul preparations – wild and recombinant with group specificity, for example *Autographa californica* (Hoover et al., 1996) affecting mulberry pyralid and do not affect mulberry silkworm (Madyarov, 2008). Besides, some bacterial, fungal and nematode preparations can be used after cocoons seasonal harvest (end of may in Uzbekistan). But virulence of used strain in any form completely have to disappear under the affect of biotic and abiotic factors before the following season of silkworm feeding in sericulture. Their use is possible together with "botanical" insecticides, as well as with some chemicals whose mode of their action is safe for animal and man (Madyarov, 2008). Herewith very importance economical, fine dispersed and pervasive applying of preparations into infected zones of the plants.

For full liquidation of the pest it is necessary to use total, destructive actions after cold winters significantly reducing its population (Madyarov et al., 2008).

Thereby problems appeared with broad spreading of the serious pest of the mulberry - mulberry pyralid *Glyphodes pyloalis* Walker can be solved by extensive integrated control with preferential use of natural agents in combination with eco-friendly preparations, with land treatment and favorable meteorological conditions.
Keywords: mulberry, pest, *Glyphodes pyloalis* Walker, eco-friendly control, entomophages, entomopathogens, safe insecticides, cold winter

NEW SELECTIVE MULBERRY VARIETY "FAZISI"

By

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The mulberry variety "Fazisi" has been developed by sowing of seed obtained through free pollination of the variety "Kutaturi", via strict repeated selection, at the Moriculture Base of Kutaisi Zonal Experimental Station of Sericulture. It belongs to Morus alba Lin variety.
It is a plant of moderate development, masculine. It is characterized with open crown, straight branches, brown sprouts and low, triangular buds; whole-lamina, cordate, dark green leafs of good consistency and moderate thickness; flowers – cylindrical, incomplete density flowers. Flower clusters sit in groups on branches.
Growing and non-growing sprouts ratio on the branch - 1:1. Sprout is of fine cellular anatomy, with additional conducting fascicles in leafstalk medulla, with abundant druses and cystoliths in leaf mesophyll, optimal ratio of moisture and dry matters (70%-30%) and that of protein/carbohydrates (1:0,9).
The variety is of leaf direction; it is distinguished by leaf consistency and nutritive value. The variety is stable to mycoplasm disease - mulberry leaf curl. It is recommended for spreading in West Georgia. It is zoned since 2010.
Keywords: mulberry, new variety, leaf, sprouts

NEW SELECTIVE MULBERRY VARIETY "AISI"

By

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Mulberry variety "Aisi" was developed by sowing of seed of polyploidy form mulberry "Triploid-20" and repeated strict selection in population.

It belongs to Morus alba Lin. variety. It was subjected to initial stationary testings in 1989-90 at the Khoni nursery and from 1994 to 2005 at the Experimental Base of Moriculture of Kutaisi Zonal Experimental Station of Sericulture under direct supervision of leading workers of the base. The variety is feminine.

The variety is characterized by a strong, developed crown, intensively growing straight form branches. Its branch is of grayish color, with moderate size inter-joint distance and small size buds. Leaf is whole-lamellar, big, with uneven surface. Growing sprouts prevail on the branches. The variety is characterized by abundant leafing; its fructification is average, seed yield from the fruit -low (2,1%). In leaf mesophill the spongy parenchyma prevails. Cystolith is oblong, oval. In blast medulla additional conducting beams prevail.

The variety is practically stable to infectious diseases. The variety is of abundant fructification, leaf is of high nutritive value and is distinguished by high edibility. The variety is recommended for spreading in West Georgia as a leaf designation variety. It is zoned since 2010.

Keywords: mulberry, leaf, developed crown, new leaf variety

CHEMICAL COMPOSITION OF LEAF OF PERSPECTIVE MULBERRY VARIETIES GROWING IN INNER KARTLI REGION

By

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Among the measures of struggle against mulberry leaf disease – rugosity alongside with obtaining of new, highly productive varieties, search of local, immune or relatively resistant selection forms is extremely urgent. Expedition studies for mulberry plants in Inner Kartli region fixed several selection forms distinguished by their leaf morphology. These are Kaspi-5, Okami-41 and Mukhrani-21. On the base of the study of chemical composition of their leaf it was proved that all those three forms satisfy the demands fixed for necessary criteria for mulberry silkworm. Thus, for example Okami-41 is the best by its protein-carbohydrate component ratio as well as by the content of vitamin C and tannins. The above referred forms are studied to estimate their immunologic characteristics at the natural infectious background in the zone of diseases.

Keywords: perspective mulberry forms, leaf chemical composition

Introduction: Spreading of mulberry plant in Georgia has a rather long history. This plant is considered aboriginal one of the Caucasus and is spread in Georgia from the beginning of the 4th century B.C. Natural conditions of the Caucasus are so favorable for the mulberry, that its wild forms are met on the coastal zone of the Black Sea, in Kakheti, Kartli till today. In various parts of Georgia are found mulberry forests, thus for example the Sagarejo mulberry forest massifs, big massif of Lezhbadini in Marneuli region, mulberry forests in the vicinity of Tsnori, Khobi, Chaladidi and other settlements. The plant is encountered in great quantities on the banks of rivers Mtkvari and Alazani and other rivers of Georgia [3].

Industrial mulberry varieties are distributed in almost all regions of Georgia, up to 1000-1200 meter above the sea level, and in connection to the rest favorable conditions sericulture was accordingly developed. Alongside with it, mulberry cultivation has diverse applications, and therefore the prospects of its development are too great.

The issue of strengthening the nutritive base for sericulture in Georgia has paid especially great attention, from the 30s of the last century, and rather significant success was achieved. In 1932 there were 4.500.000 registered mulberry plants in Georgia [4], and in 1964 their number exceeded 15 million plants, reflecting to the highest levels in the history of the Georgian sericulture. Later the number of mulberry plants decreased dramatically, due to the spreading of mulberry dwarf disease in West Georgia. In the first decade of the 20th century, due to this disease the nutritional base for sericulture decreased by 11 million plants. Due to the efforts of researchers this deficit was cured by the 80-90s, mostly with the creation of some hybrid mulberry forms, producing considerably less foliage. From the beginning of the 90s in the leading sericulture regions of Georgia, like Akhmeta, Telavi, Gurjaani, Lagodekhi, Kvareli and Sighnaghi regions, mulberry leaf contamination was systematically observed. The only region by that period where the symptoms of the above mentioned leaf disease were not observed, was Kartli. Therefore, study of the variety composition of mulberry plantations in this area could enable us to avoid new contaminations and on the base of healthy material to perform the so called genetic prophylaxis.

Currently the nutritional base for sericulture in the republic of Georgia becomes from 5 million mulberry plants, 2 million of them being trees in the form of plantations, and the remaining portion representing single plants in rural areas [2]. In order to restore the nutritional base of sericulture, alongside with other measures, it is necessary to introduce tolerant to the disease varieties in the free from infection zones and realize their intense application in the sericulture industry.

Material and methods: To identify old varieties in mulberry plantations existing in Kartli region and to present new interesting forms among them, in years 2008-2010 identification studies were performed. Plantations were studied and registered according to morphological characteristics and biological particularities. Within that study interesting specimens were fixed, which were studied according to diagnostic correlation signs, like anatomical structure of sprout and leaf mesophile and by leaf chemical composition. From the scions taken from the mulberry forms, in the stage of hibernation, the material was propagated by means of clone selection and currently it is tested for the infectious background in the Kutaisi Experimental Zonal Station of Sericulture

Results and Discussion: On the basis of two-year identification studies in the mentioned leading sericulture regions of Shida Kartli regions of Georgia (Kareli, Khashuri, Kaspi, Mtskheta, Digomi), there were registered the numbers of mulberry plants. It should be stated that trees groq rather sparsely in the plantations (4.0-4.5%). Due to incorrect exploitation and absence of adequate agro-technical background, the plants are in bad condition and their productivity indices are low. Identification of tolerant mulberry varieties in the above referred region and installation of new plantations is very urgent. The data about mulberry plant, collected in this study, is given in Table 1.

Table 1. Indices of mulberry plantations and unit plants in Kartli region

Region	By 1st January 1990		Total in the region		By 2008-2010 year	
	In the form of	In the form of	number	%	number	%

	plantations number	unit plants number				
Shida Kartli	896000	254000	1150000	6.3	355000	7.1
Qvemo Kartli	355000	246000	601000	3.3	212000	4.2
Mtskheta-Tianeti	189000	52000	241000	1.3	86000	1.7
Total, in the region	144000	552000	1992000	10.87	653000	13.06
Total, in the republic	9330000	8994000	18314000	100.0	5000000	100.0

As it comes out from the analyzed data, the mulberry plants in Kartli region in the period up to 1990 represent 10,8% of total plants grown in the Georgian republic. In the period that followed the existing plantations were mainly preserved and the quantity of plants was somehow increased (by 2,095%), through new plantations on private land plots. In that point we should state that the new mulberry plantations are mainly fruit varieties or hybrid forms.
During May month plant tissue samples, 1 kilogram per form, were taken from the interesting mulberry forms of Shida Kartli region. The samples were brought to air-dried weight and the nutrient contents were determined. These were simple and total sugars, sucrose, total and protein nitrogen, vitamin and tannin content, which determine leaf nutritive value. Results of the study are given in Table 2.

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Indices	Kaspi 4 (1)	Okami 5 (1)	Mukhrani 21
Simple (inversion) sugars g/100(%)	1.20	1.50	1.50
General sugars g/100%	2.20	3.03	3.03
Sucrose g/100(%)	0.95	1.45	1.45
General nitrogen, %	2.59	2.80	2.21
Protein nitrogen, %	2.14	2.34	1.81
„C" vitamin, mg/100g	13.20	11.0	13.20
Water soluble tannin, %	**0.276**	**0.279**	**0.249**
Alkali soluble tannin,, %	0.369	0.384	0.379

The data of the Table prove that Okami 5(1) variety leafs are rich in total carbohydrates, proteins and alkali soluble tannins. C-vitamin content is slightly higher in the leafs of Okami 4(1) and Mukhrani 21. As to the protein-carbohydrate ratio, which, according to the data of

researchers [1-5] is in positive correlation with leaf nutritive value, it is given in optimal ratio in Mukhrani-21 (1:0.70). In other forms the ratio reaches the desired optimum. In the leaf of Kaspi 4(1) the ratio is 1:0.91, while in Okami 5(1) is 1:0.85.
In conclusion, by chemical composition, the leafs of new mulberry forms are of considerable value for use in sericulture.
Clones of new mulberry forms are studied in respect to the dwarf disease natural infectious background , at the Kutaisi Sericulture Zonal Experimental Station.

Conclusion: New mulberry forms of Kartli region, distinguished by their morphological indices – represent the best starting material for selection:

1. On the basis of leaf chemical analysis all three of mulberry, namely Okami 5(1), Kaspi 4(1) and Mukhrani 21 should be inserted in leaf quality selection as starting material.
2. New mulberry forms introduced through this work, in the infection free zone of Shida and Qvemo Kartli, are rather important for the mulberry selection process and the mulberry gene resources of Georgia.

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INFLUENCE OF STOCK MATERIAL ON THE CHARACTER OF GROWTH AND DEVELOPMENT OF SAPLINGS AND INTENSITY OF FOLIAGE

By

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The present article deals with the influence of stock material on the exit of standard saplings, on their growth and foliage degree of industrial varieties of new mulberry forms: #6, #213, #10 and Kutaturi. Annual seedlings obtained as a result of free, natural pollination, and by mating of selected parental forms of varieties, resistant to dwarf disease – Kutaturi and Imeruli-2 – were used as stock material.
The advantage of hybrid saplings, received by artificial pollination was proved. For the varieties #6, #213, #10 according to all indicators hybrid stocks received as a result of a

combination Kutaturi X Tbilisuri, are biologically most perfect. The saplings of #6 obtained on the same stock are characterized by strong growth rate, #10 - by slow rate, and #213 occupies intermediate position. The variety #10 is distinguished by the intensity of the foliage.
Keywords: new mulberry varieties, foliage intensity

POLISH WHITE MULBERRY (*MORUS ALBA* L.) AND NEW DIRECTIONS OF ITS UTILIZATION

By

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(ORAL PRESENTATION)

Polish cultivar of white mulberry – "Żółwińska wielkolistna" was bred in 1950's in Milanówek, near Warsaw, Poland. It characterizes with huge leaves and rapid growth, because this cultivar was designed for mulberry silkworms (*Bombyx mori* L.) breeding. These days, when the European sericulture undergoes crisis, sericulturists must find new directions of mulberry utilization. The aim of this presentation is to show the studies on the Polish cultivar of white mulberry and propose future course for the development of the industry.
Keywords: white mulberry, cultivar, industry

Introduction

Morus alba Linnaeus, 1753 is one of the numerous species in the family Moraceae. Most of the species are native to Asia. These plants are characterized with milky sap in shoots. They are both monoecious and dioecious, their flowers are inconspicuous and odorless and the small, sweet fruits are multiple: drupelets or nuts. The leaves are alternately arranged, simple, often lobed and serrated on the margin (Litwińczuk 1993; Butt 2008).

There are numerous uses of white mulberry known for centuries. It was well known that infusion and tea of leaves are healthy and they were considered as diaphoretic and emalliorent and applied for gargling in inflammations of throat. The fruits give cooling effect and are used as a laxative, the roots possess anthelmintic activity and astringent properties and the bark is used as a purgative and vermifuge (Sharma 1994). However, white mulberry was mainly known for its excellent antidiabetic action.

These days we know, that white mulberry contains a lot of active compounds, which are very precious for human health. The leaves and fruits contain 15-31% high quality protein, crude fiber, 200-300 mg/100g of ascorbic acid, of which over 90% is present in the reduced form, vitamin B, D, folic acid, folinic acid, β-carotenes and essential macroelements (K, Ca, Mg, Na, P) and microelements (Fe, Zn, Ni) (Srivastava 2006; Ercisli 2007; Imran 2010). Moreover, there is a lot of flavonoids (quercetin, rutin, isoquercitrin, astragalin, kuwanon G and C, catechin, mulberrofuran G, albanol B, morusin, sanggenon B and D), which exhibit strong antioxidant activity (Kim 1999; Doi 2001, Kofujita et al. 2004),

antifungal and antibacterial potential against harmful strains of bacteria (Shirata 1982; Park 2003) and against viruses HSV-1 (Kimura 2007; Butt 2008). Moreover, mulberry flavonoids lower significantly blood glucose levels by inhibiting enzyme activity (Oku 2006), prevent and inhibit of atherosclerosis by strong inhibitory effects on LDL oxidation and increasing resistance to blood cholesterol deposits (Chen 2006, Butt 2008). What is more, the polysaccharides from the bark of mulberry roots stimulate lymphocyte proliferation and reduce the production of antibodies (Kim 2000, Butt 2008). In addition, the mulberry cyanidin protects the brain against endothelial dysfunction and reduces the likelihood of Alzheimer's disease (Serraino 2003). The literature data also reported considerable capacity of mulberry for local whitening of skin, so called depigmentation (Fang 2005).

There are other ways of using this multipurpose tree. Leaves of white mulberry were and still are used as a fodder for mulberry silkworms (*Bombyx mori* L.). In India all annual shoots, available after silkworm breeding season, are cut, dried and used as the main renewable source of fuel (Chinnaswamy 1995). Moreover, mulberry may be used as a natural dyeing plant (Sharma 1994), in the paper production, furniture and sport equipment industry and as a substrate for oyster mushrooms *Pleurotus* sp. (Madan 1992). Mulberry leaves (not only fruits) are eaten by vegetarians, both leaves and fruits after drying are applied as fodder for birds, reptiles and rodents. In addition, mulberry may be also used in gardening.

The aim of this paper is to present the old, Polish cultivar of white mulberry Żółwińska and find new directions of mulberry use in Polish conditions.

Material and Methods

All studies are carried out on an old, Polish cultivar Żółwińska, which was bred in 1950's in Milanówek, near Warsaw, Poland. These days there is established a proecological plantation in Experimental Farm INF&MP in Petkowo (52,12N; 17,15E). The studied material was: shoots, leaves and fruits of Żółwińska cultivar and leaves and shoots of China and Kokuso cultivars (from experimental plantation in Petkowo). There were measured: morphological features, energy value of shoots, cellulose and pectin contents in shoots and fatty acids content in seeds.

The morphological features were carried out in July 2010. There were measured: length and width of the leaf, petiole length, distance between the leaves on the shoot, leaf color, fruit length and the stalk of a fruit. One hundred samples for each examination were taken. Present measurements of Żółwińska cultivar were compared with two the most similar cultivars: Kokuso and China (with exception of fruits studies). All mulberries are cultivated in the same plantation conditions.

The energy value of white mulberry Żółwińska was examined at the Department of Environment Protection INF&MP. The dried annual shoots collected in July 2009 were used in the investigation. The research was carried out in the oxygen bomb calorimeter type KL-5.

Content of cellulose and pectin was examined in the Harvesting Technology and Fibrous Raw Material Evaluation Department INF&MP. The material – annual shoots – was collected in June 2010, cut into 3-4 cm peaces and died. Samples were melt in the mill Pulverisette 19 and then wax and grease substances were removed. After chemical treatment the cellulose content was calculated according to the pattern:

$$C = \frac{m_1 x(100 + W)}{m_0} \ (\%)$$

where m_1 – constant mass of cellulose (in g), W – moisture of sample (in %), m_0 – initial mass.

After chemical treatment the content of pectin was calculated according to the pattern:

$$P = \frac{m_1 x 5}{m_0} \text{ x } 100 \text{ (\%)}$$

where m_1- constant mass of pectin (in g), m_0 – dry sample weight (in g), 5 – factor.

Fatty acid content was studied in the Department of Linseed and Hemp Seed Research and Processing INF&MP. Seeds were collected from fresh black fruits, dried and melt. Extract of seeds after chemical treatment was examined in the gas chromatograph Perkin Elmer with flame detector (FID). Computer software TurboChrom makes all calculations of the fatty acid profile according to the pattern:

Pk [%] = P1/(Pc)

where Pk – % fatty acids, P1 – % P1 surface of detected fatty acid, Pc – [%] (P1+ P2+P3...Pn).

Results and discussion

The morphological measurements show that the Polish cultivar Żółwińska possesses the best features within compared cultivars. The leaves are the biggest, the petioles are the longest, shiny leaves are dark green coloured, with deeply serrated margins, the average length of black fruits is 1,59 cm and they are set on stalk (average length 0,8 cm). Such a huge leaves possess higher content of precious active substances (eg. flavonoids, vitamins and minerals) what is valuable for medicine and pharmaceutical industry. Moreover, bigger leaves are much better food for mulberry silkworms. Present studies do not include fruit measurements of China and Kokuso cultivars, because these mulberries are too young to fruit. In the future there are planned more detailed measurements. The comparison of studied cultivars features is given in Table 1.

The cellulose content of Polish cultivar was calculated on level 30,27 % for annual shoots (moisture 8,38 %) and 33,59 % for two years old shoots (moisture 7,65 %). The results were similar for China and Kokuso mulberries (Fig. 1). Present studies give worse results than that of previous mulberry examinations (Sharma 1994), where were noted much higher results: cellulose (57,4%), hemicellulose (16,3%) and lignin (24,6%). This difference may be due to features of another cultivar or different method of analyses, which was not given.

The pectin content of Żółwińska cultivar was calculated on level 6,14 % for annual shoots and 3,34 % for 2 years old shoots. This decreasing trend was recorded also in other studied mulberries (Fig. 2).

The huge energy value – 17,9 MJ/kg was recorded. This value is a little bit higher than earlier noted (17,0 MJ/kg in Li et al. 2009). Moreover, it is possible to obtain 14-17 tones/ha of biomass (Sharma 1994; Łochyńska 2011). This energy potential, considerable resistance to disease and pests and relatively low soil requirements make the white mulberry a valuable plant for energy industry. Mulberry plantations provide a low utilization of productive or degraded agricultural land. Therefore, it may be used to produce heat, electricity, in fuel production and as slurry in anaerobic digesters.

The fatty acids examination shows that within 13 recorded acids, 7 are mono- and polyunsaturated fatty acids (MUFAs and PUFAs), which belong to very precious fatty acids group: omega-3. The highest content show: linoleic acid (LA, C18:2n6c; 76,84%) and oleic acid (C18:1n9c; 7,09%) (Fig. 3). Trace amounts of other unsaturated fatty acids: linolenic, stearidonic, eicosadienoic, eicosanoic and erucic acid were also recorded. In consideration of this, that the mulberry seeds contain 25-35% of a yellow oil, white mulberry may used as an oil-bearing plant. Detected unsaturated fatty acids are essential unsaturated fatty acids (EUFA), so called vitamin F, which cannot be produced in human organism and must be

supplied with food. Fatty acids omega-3 are very precious for our health. They prevent arteriosclerosis, thrombosis and embolism, so that they are used in prevention of heart disease. They support the development and normal brain function and visual acuity, reduce level of LDL cholesterol in the blood and the risk of cancer. Moreover, fatty acids omega-3 strengthen our body by: weakening of the inflammatory symptoms, optimising development of the nervous system, assisting the process of concentration and reduced risk of depression.

Conclusions

Undoubtedly, this multipurpose plant may be used not only in sericulture. These days, when white mulberry is used also in sport equipment industry, in furniture industry, as a dyeing plant, in paper industry, in production of oyster mushrooms, as organic fertilizer, as binding and cooperage materials, as fodder for animals, it is believed that huge potential of white mulberry still is not exhausted. There is a huge need to use this precious plant in pharmaceutical industry, medicine and food industry in bigger scale in the age of lifestyle diseases (diabetes, atherosclerosis, hypertension). Moreover, still increasing demand for energy causes the pressure for new sources of renewable energy, what gives a large chance to white mulberry. It is hoped that this very valuable plant will be appreciated not only in Poland but also in other countries of EU, because the use of mulberry potential certainly will develop several economic sectors.

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Table 1. The comparison of morphological features of studied cultivars of white mulberry (all measurements in cm).

Feature	**China cultivar**	**Kokuso cultivar**	**Żółwińska cultivar**
length of leaf	10,55	10,45	19,45
width of leaf	7,7	8,25	12,34
length of petiole	2,38	2,06	4,49
distance between petioles	6	4,64	5,8
color of leaf	light green, mat	light green, mat	dark green, shiny

Figure 1. Comparison of cellulose content of China, Kokuso and Żółwińska cultivars (in %).

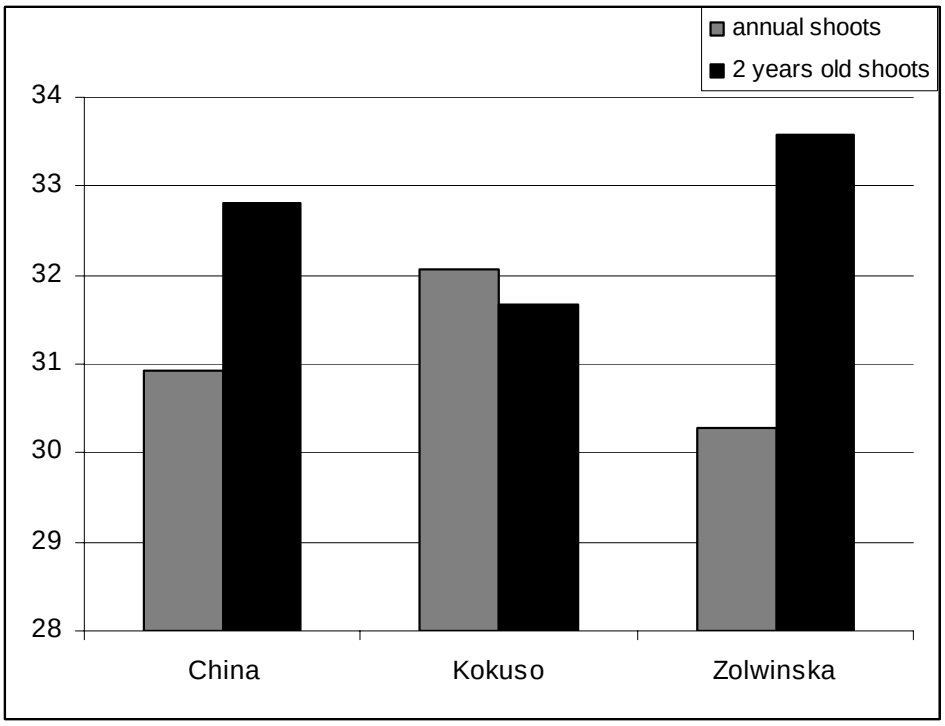


Figure 2. Comparison of pectin content of China, Kokuso and Żółwińska cultivars (in %).

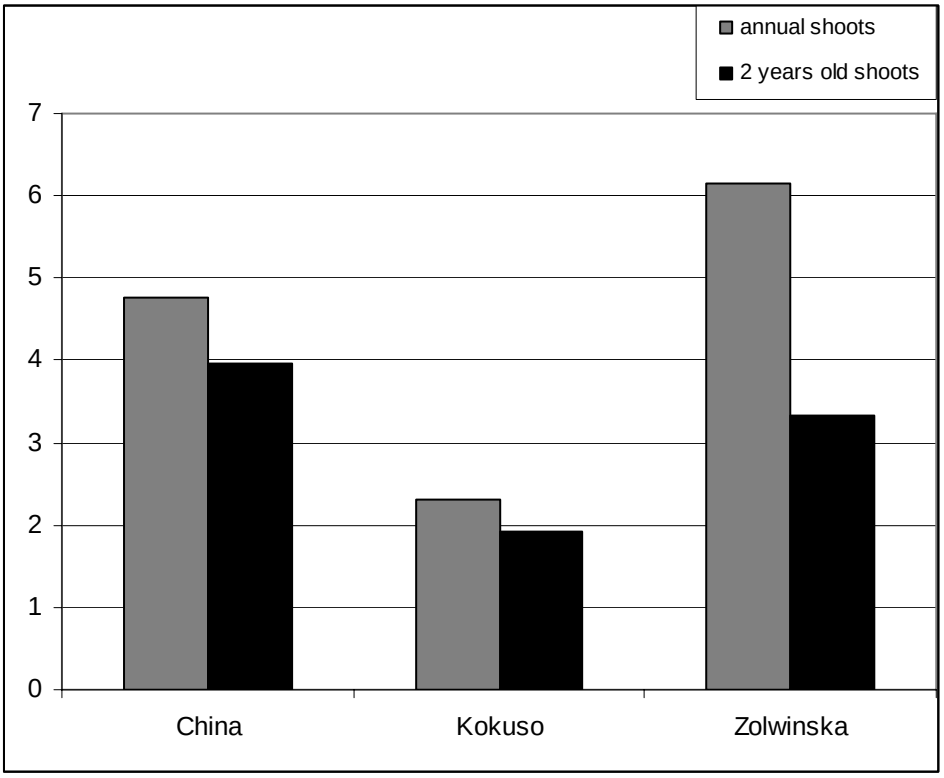
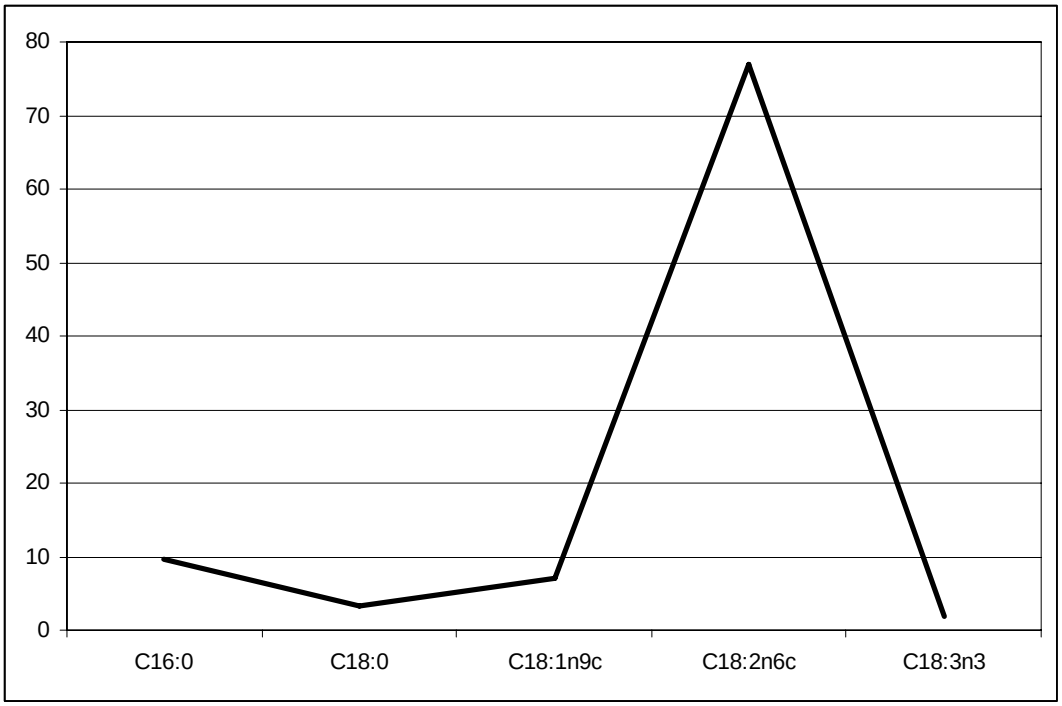


Figure 3. Selected fatty acids content of Żółwińska cultivar (in %).



FORECASTING OF ECONOMIC INDICES OF NEW MULBERRY FORMS ACCORDING TO CORRELATIVE SELECTION AND CORRELATIVE CHARACTERISTICS

By

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On the basis of analysis of experiments carried out at the Georgian Scientific Research Institute of Sericulture some regularities were determined between definite characteristics abd economic indices of mulberry varieties, which enables us to choose the desired starting selection material at the initial stage of the study.

The present paper deals with preliminary evaluation of nutritive values of mulberry leaf, productivity and resistance to diseases of new mulberry forms #158, # 104 and # 608 (leaf withering and nutritive value) according to diagnostic and correlative selective characteristics.

Keywords: mulberry, correlative selection characteristics

ORGANIC SERICULTURE FOR BIVOLTINE PRODUCTION

By

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(ORAL PRESENTATION)

Abstract: Organic farming will help to improve mulberry foliage productivity and soil biological properties. Soil health is very important aspect to be taken care to get nutritious foliage for bivoltine silkworm productivity. The farmers who adopted organic sericulture were able to get good bivoltine production and farmers who did not adopt organic farming were not able to get good bivoltine productivity. Progressive sericulturists of South India were given technical guidance by spot demonstration method on adoption of organic sericulture. The data pertaining to mulberry productivity was recorded for three years from the sericulturists with organic and inorganic agri-practic. The present study enumerated important findings:

1. Organic sericulture has to be intensified in farmers fields to increase bivoltine production.

2. Organic sericulture is the best method to improve soil health.

3. Leaf photosynthetic efficiency has got direct role in bivoltine productivity.

4. To increase world bivoltine production, organic sericulture is the only best solution.

Organic farming will help to improve mulberry foliage productivity and soil biological properties. Soil health is very important aspect to be taken care to get nutritious foliage for bivoltine silkworm productivity. The farmers who adopted organic sericulture were able to get good bivoltine production and farmers who did not adopt organic farming were not able to get good bivoltine productivity. In 21st century organic sericulture has immense value in bivoltine production.

INTRODUCTION

China has a history of over 5000 years for sericulture. Nearly 30 million farmers are involved in sericulture production in China. Cocoon production is about 500,000 tons per year and nearly 70% of the total production of the world. The organic farming is effectively practiced in China for mulberry foliage production, where as in other Asian countries including India inorganic farming has taken upper hand in mulberry foliage productivity in comparison to organic farming in farmer's fields. Therefore, sustainability in bivoltine silk production has not been achieved in India. Hardly 10% of total silk production is bivoltine in India.

Organic sericulture has developed rapidly and practiced in China in farmers fields. Organic sericulture helps for minimization of environmental pollution. Soil biological properties are enhanced and bivoltine silkworm crop losses are minimized. One of the effective ways of increasing the yield of cocoon per unit area of mulberry is to improve nutritive values of mulberry leaves. The higher the quality of the leaves fed to bivoltine

silkworm, the lower is the quantity of leaves required by silkworm (Shablovsakaya and Kafian, 1967). In present scenario of 21st century, the challenges before the sericulturist is how well he can manage the farm to enhance returns on a sustainable basis by way of increasing bivoltine productivity followed by improvement of economic efficiency.

Bongale and Dandin (1993) emphasized the effectiveness of nitrogen fixing bacterial biofertiliser in mulberry cultivation. Watanabe (1984) concluded in his research studies that use of green manure is very important aspect as a source of organic matter in rice cultivation. Therefore, sericulturists of Tamilnadu are using biofertiliser in more quantity as organic resource and cultivation of sunhemp as green manure to build up soil organic matter. Organic agriculture has developed rapidly in China and spread around the world (Biao, X and Xi aorong, W., 2003).

To meet the challenges of bivoltine production in Asian countries, organic sericulture has to be intensified in seri-productivity. Wide spread use of inorganic fertilizers has affected soil health and in turn affected the bivoltine production.

METHODOLOGY

Progressive sericulturists of South India were given technical guidance by spot demonstration method on adoption of organic sericulture. The data pertaining to mulberry productivity was recorded for three years from the sericulturists with organic and inorganic agri-practices.

RESULTS AND DISCUSSION

The data pertaining to mulberry and silkworm productivity are depicted in figures 1 to 6. The mulberry leaf productivity was higher in organic farmers and with out organic farming affected mulberry productivity. The foliar diseases of mulberry are completely controlled in organic farming fields. The organic farming foliage photosynthetic efficiency is better in comparison to inorganic foliage photosynthetic efficiency. Organic farming adopted by sericulturists got good bivoltine crop productivity and sericulturists with inorganic farming were affected by silkworm crop losses due to diseases. The use of biofertiliser and cultivation of green manure crop has helped sericulturists of Tamilnadu to improve soil health and organic carbon content. Due to this, sericulturists are able to produce high quality bivoltine silkworm productivity. Organic carbon content and nitrogen content of the soil play major role in production of nutritious leaf productivity. Therefore, organic sericulture will help to improve bivoltine silkworm productivity.

The present study enumerated important findings:

1. Organic sericulture has to be intensified in farmers fields to increase bivoltine production.
2. Organic sericulture is the best method to improve soil health.
3. Leaf photosynthetic efficiency has got direct role in bivoltine productivity.
4. To increase world bivoltine production, organic sericulture is the only best solution.

CONCLUSION

Organic matter is one of the most important constituents of the soil and from antiquity man has recognized its importance in regulating soil fertility at desirable levels. Organic sericulture is the only means to achieve the sustainable target in bivoltine productivity in Asian countries.

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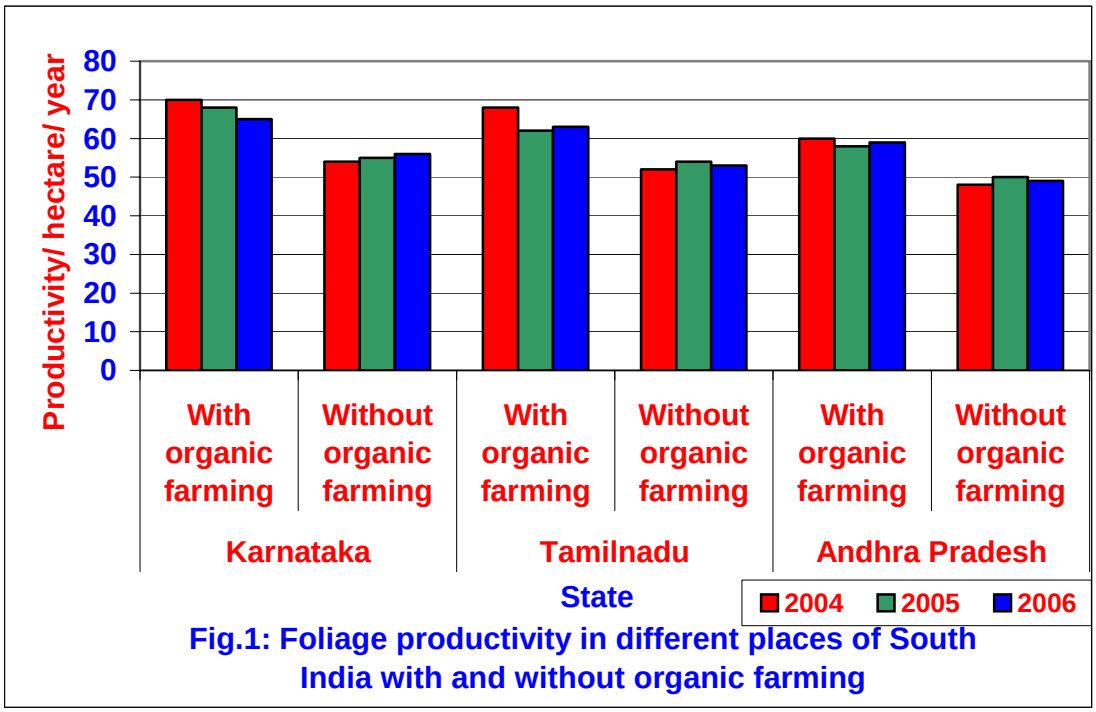

Fig.1: Foliage productivity in different places of South India with and without organic farming

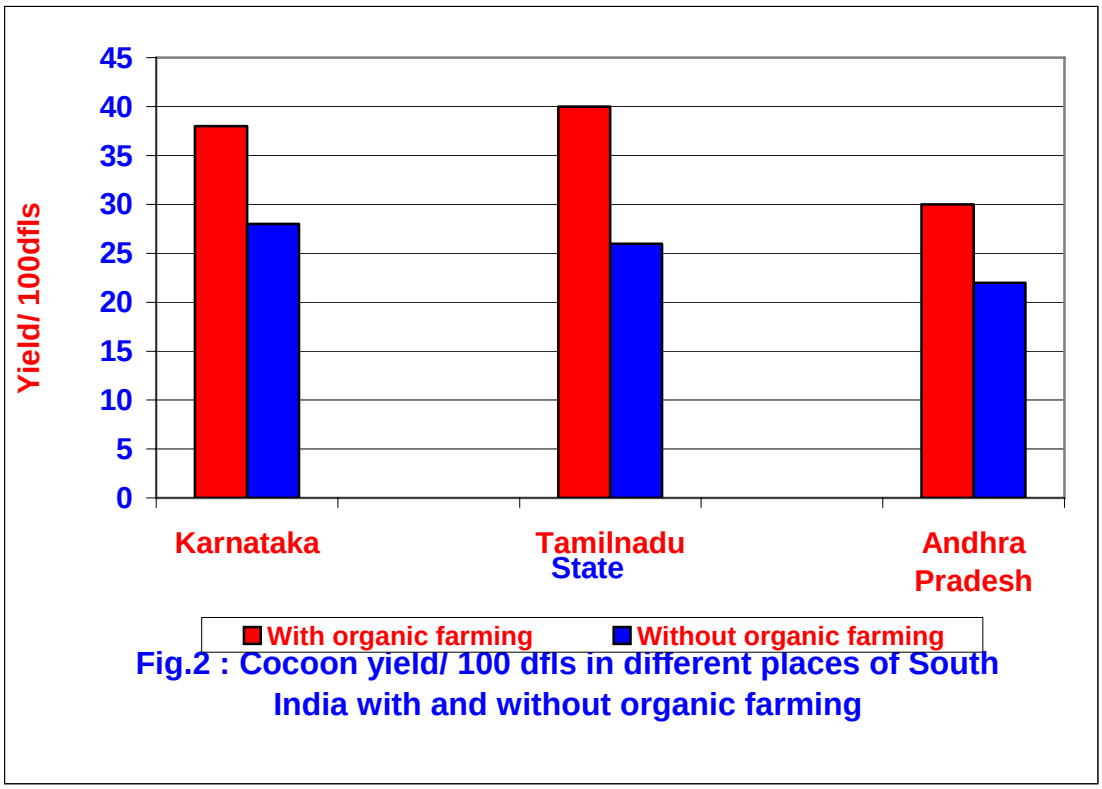

Fig.2 : Cocoon yield/ 100 dfls in different places of South India with and without organic farming

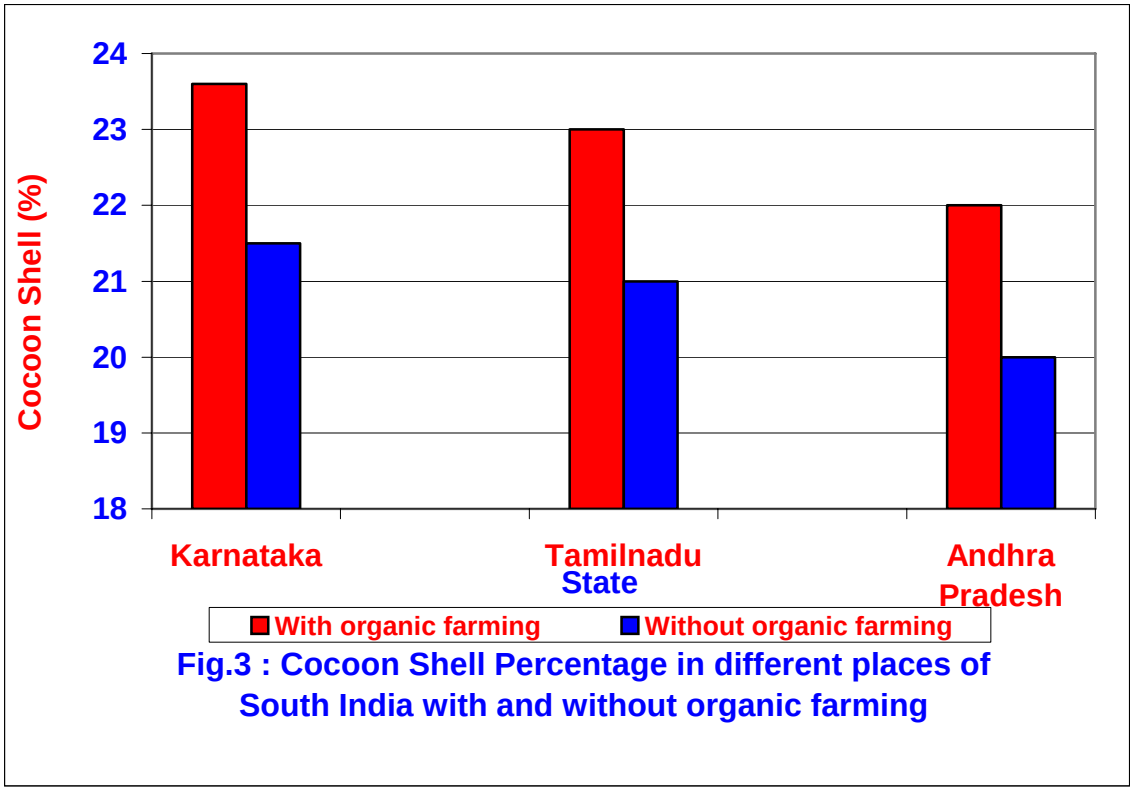

Fig.3 : Cocoon Shell Percentage in different places of South India with and without organic farming

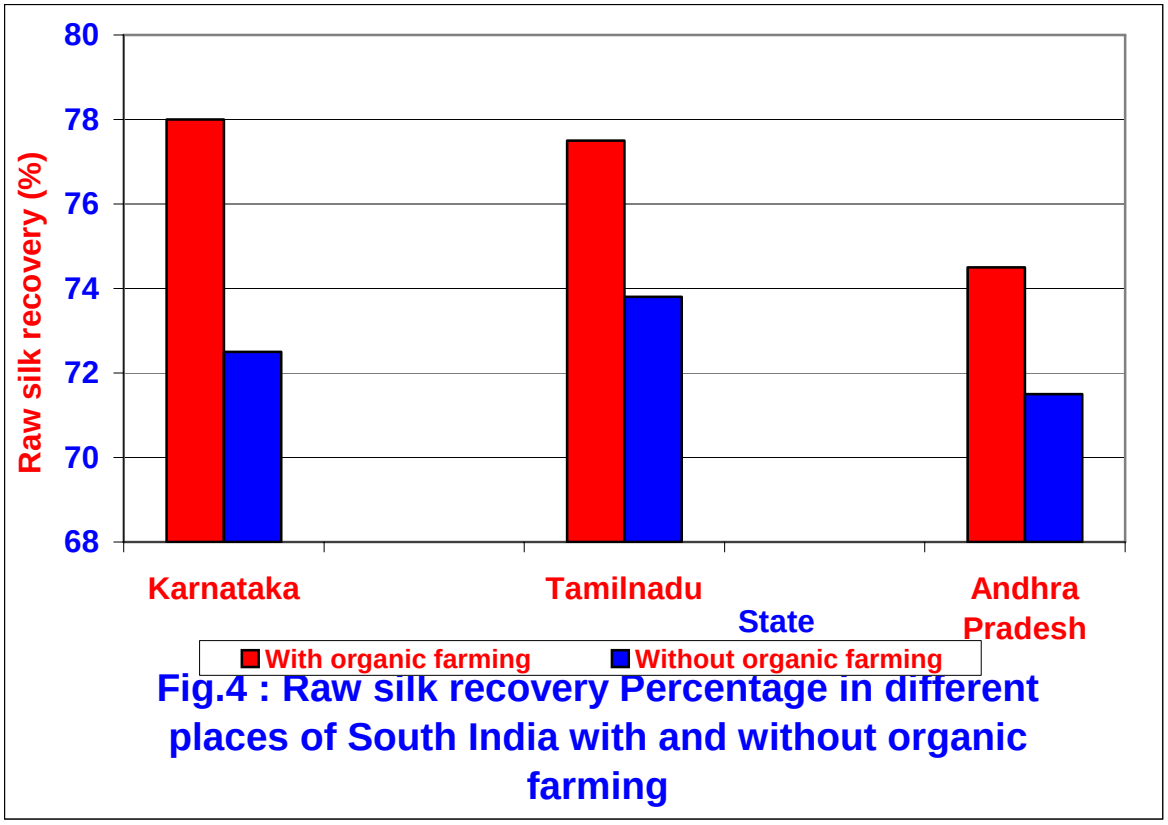

Fig.4 : Raw silk recovery Percentage in different places of South India with and without organic farming

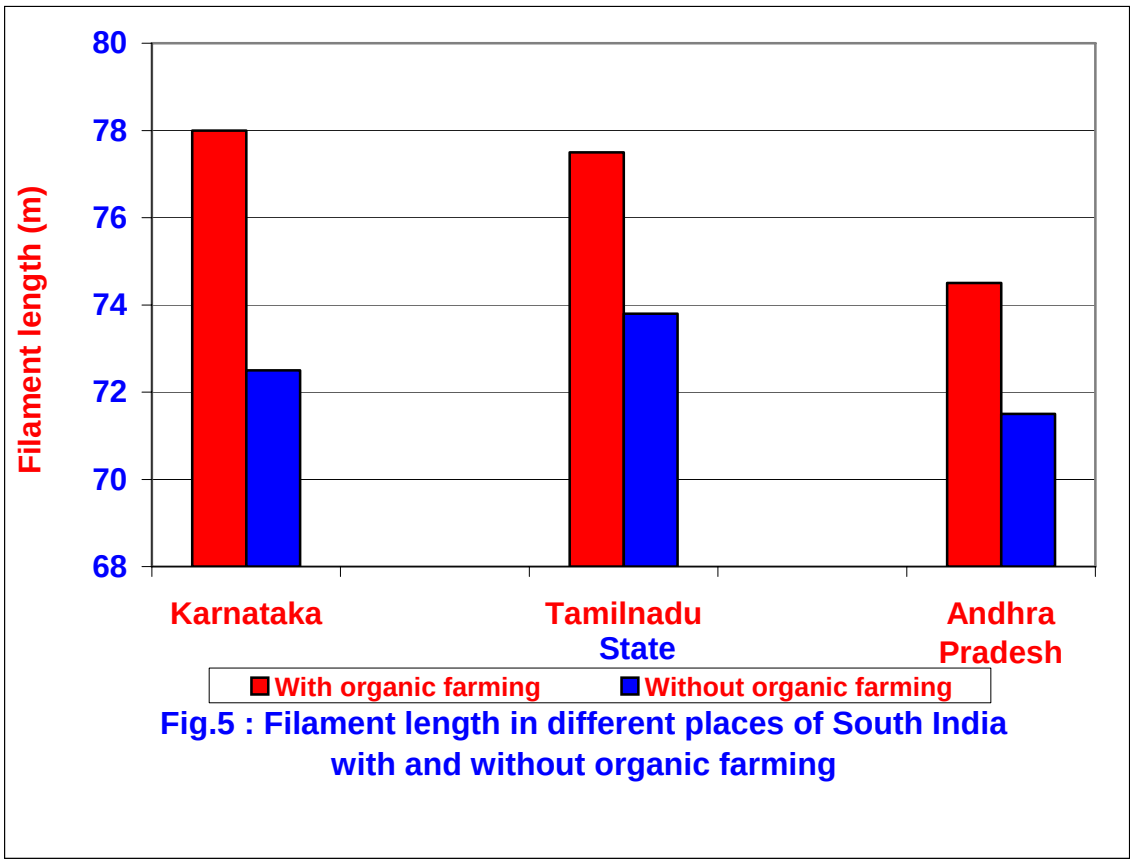

Fig.5 : Filament length in different places of South India with and without organic farming

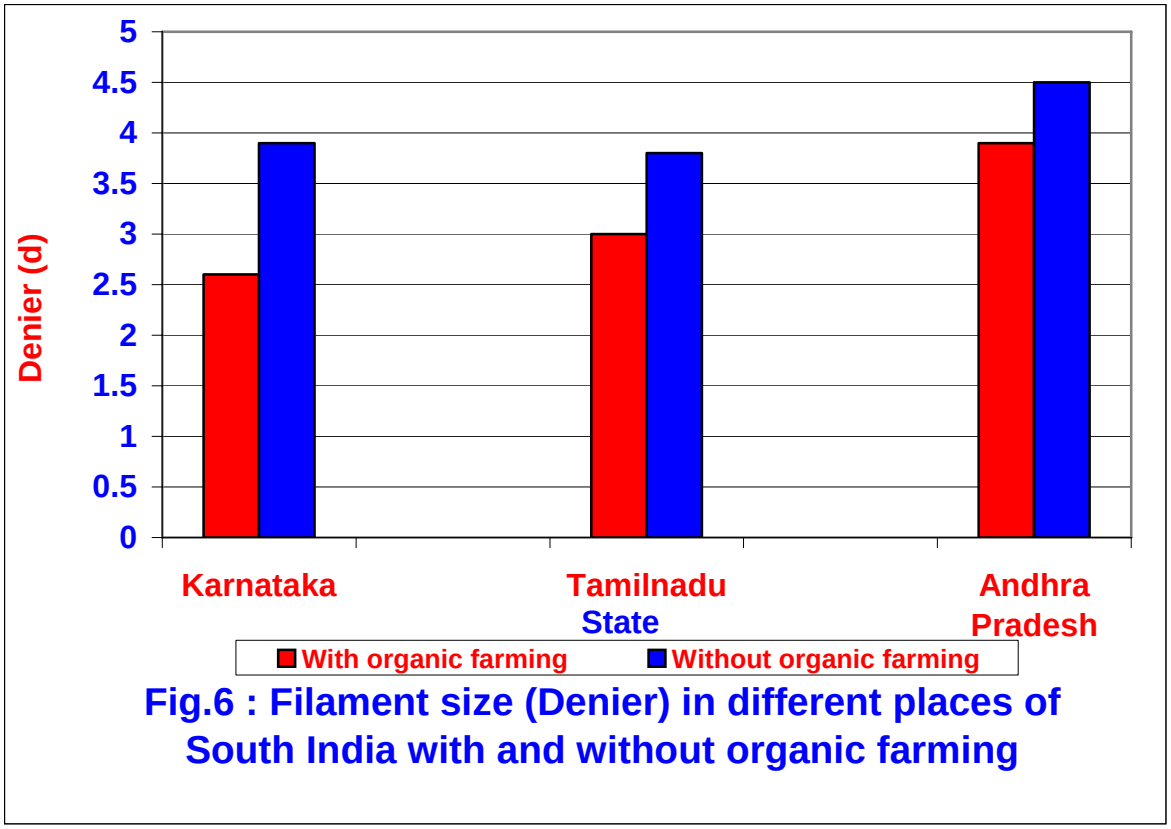

Fig.6 : Filament size (Denier) in different places of South India with and without organic farming

CO_2 CHANGES AND CHLOROPHYLL CONTENT IN DIFFERENT RESISTANT MULBERRY (*MORUS*) LEAVES DISEASED WITH PHYTOPLASMA

By

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CO_2 changes on the light and in the dark, also content of chlorophyll „a" and „b" in the visual healthy and diseased with phytoplasma mulberry leaves was studied. It was examined Japanese varieties: resistant Oshima, midle resistant Takaisshi and not resistant Kairio Nezumigaesi.

It is established that in September when the disease is exspresion at most the visual healthy leaves of Oshima absorb CO_2 1,6 time strongly than leaves of Takaisshi, but leaves of not resistant Kairio Nezumigaesi secrete CO_2 on the light. CO_2 is secreted from diseased leaves in spite of resistant variety. In the dark CO_2 is secreted all the more so decreased resistance of variety. In diseased leaves decreased content of chlorophyll „a" and „b", „a" + „b", „a" : „b", especially in not resistant variety.

The changes of diseased leaves call for intensification of dissimilation, gradual exhaustion and destruction of diseased plants.

Keywords: Mulberry, phytoplasma, CO_2 Changes, Chlorophylls

Livelihood of mulberry tree as a autotrophic organism integrally depend on the balance of photosynthesis and respiration. It is determined that in the diseased with phytoplasma mulberry leaves upset the water balance, transpiration intensity and circadian rhythm of stomata [1], structure of mesophyll [2] and conductive system [3,4], ATP activity [5], content of plastid pigments [6]. Pathological changes of photosynthesis, respiratory and chlorophyll content of leaves in different resistant mulberry varieties in conditions of Georgian are studied poorly.

Object of the work was to study of photosynthesis and respiration intensities, also content of chloroplast pigments in the leaves of the mulberry varieties with different resistant.

Methods

The work was done in the Sericulture Experimental Zonal Station of Kutaisi (West Georgia). It was studied Japanese varieties of mulberry with different resistance to phytoplasma disease molberry dwarf – Oshima, Takaisshi and Kairio Nezumigaesi were studed. The plants were with strong symptoms and without visual symptoms of the disease. Age of the plants - 30 years. They were exploited every year in May. Age of leaves - 3 months, from south exposition.

CO_2 content changes according the light and dark was studied by conduct metric method [8] in the field condition, pigment content by spectrometric method [9]. Biological recycling 3 times. Results are presented as average arithmetic quantity of measurement.

Results

During the experiment air temperature was 25^0-28^0C, relative humidity (RH) 55-63%, light intensity 3000-10000 lux (table 1). The leaves areas in strongly diseased varieties were very reduced (table 1), which is characteristic feature of the mulberry dwarf disease.

Table 1

Characteristics of environment and mulberry leaves areas at the moment of the experiment 16^{th} September, 10^{00}-12^{00}.

Variety	Category of resistance	D Symptoms	Light, lux	Temperature, ^{0}C	AHRH, %	Leaf area	
						m^2	%
Oshima	III Resistance	Visual healthy	3000-5000	26,0	63	0,02866	100,0
		Very diseased	3000-5000	25,5	63	0,00354	12,4
Takaisshi	IV Medium resistance	Visual healthy	9500-10000	25,0	60	0,01225	100,0
		Very diseased	9500-10000	28,0	56	0,00543	44,3
Kairio Nezumigaesi	V Non resistance	Visual healthy	9500-10000	28,0	56	0,01394	100,0
		Very diseased	9500-10000	27,0	55	0,00304	21,8

Table 2

CO_2 changes in visually healthy and diseased leaves of mulberry with different resistance
16^{th} September, 10^{00}-12^{00}.

Variety	Category of resistance	Symptoms	Absorbed CO_2 in light, $mg.m^{-2}.h^{-1}$	Evolved CO_2				*NPP= =GPP-R_a
				in light, $mg.m^{-2}.h^{-1}$	in dark		$\frac{CO_{2dark}}{CO_{2light}}$	
					$mg.m^{-2}.h^{-1}$	%		
Oshima	III Resistance	Visual healthy	42,13	-	169,02	100,0	-	- 126,89
		Very diseased	-	404,13	460,41	272,4	1,14	- 460,41
Takaishi	IV Medium resistance	Visual healthy	26,12	-	194,45	100,0	-	- 168,33
		Very diseased	-	500,83	602,03	309,7	1,20	- 602,03
Kairio Nezumi gaesi	V Not resistance	Visual healthy	-	109,79	155,17	100,0	1,41	- 155,17
		Very diseased	-	512,86	858,56	553,30	1,67	- 858,56

* NPP - neto-productivity,
GPP - photosinthetical (gross) productivity,
R_a - autotrophic (night) respiration.

It turned out that visual healthy leaves of resistant variety Oshima take up CO_2 1,6 times intensively than the leaves of medium resistant variety Takaisshi. Visual healthy leaves of not resistant variety Kaitio Nezumigaesi discharge CO_2 in light. All visual diseased leaves in spite of varieties discharge CO_2 in light (table 2).

Correlation of CO_2 change according the light and dark isin inverse relation to variety resistance. $\frac{CO_{2dark}}{CO_{2light}}$ is maximum in leaves of not resistant Kairio Nezumigaesi (table 2).

Visuayl healthy leaves of resistant variety Oshima have high content of chlorophyll „a", „b" and „a"+„b". „a"+„b" content in leaves of medium resistant Takaisshi and non resistant Kairio Nezumigaesi lagsbehid Oshima on 38-27%. $\frac{,,a"}{,,b"}$ depends on the resistant of mulberry variety, it is smaller in not resistant Kairio Nezumigaesi (table 3).

Conclusions

1. Mulberry leaves chlorophills content and $\frac{,,a"}{,,b"}$ decrease in row: resistant > medium resistant > non resistant.
2. In spite of optimal environmental conditions the assimilation of CO_2 in visual healthy and diseased mulberry leaves is feeble or not observes. CO_2 outline intensity in row: resistant < medium resistant < non resistant.
3. Negative number of $\frac{NPP}{GPP}$ shows us that in mulberry leaves, especially in diseased, ones consumption of energy and mass prevail theirs production. As a result, the diseased plants deteriorate and die.
4. In aun opinion that the pathological damages in isually healthy mulberry leaves is a result of presence phytoplasma in latent form.

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THE VARIATION SOME BIOCHEMICAL PARAMETERS FROM BIOLOGICAL SAMPLES OF DUD LEAF (MORUS GENUS), CONTAMINATED WITH HEAVY METALS

By

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(POSTER)

The degradation of agricultural lands in Romania can take place by processes of contamination with heavy metals. Soils from the Baia Mare region are full of toxic substances based on lead. Research conducted in the field of the pollution of soils with heavy metals revealed several possibilities of recovery, one of which is the extraction of these metals from the soil by cultivating plants with high absorption capacity for pollutant elements. Such a plant is the mulberry tree (Morus sp.).
Heavy metals may have undesirable effects on protein, antioxidant enzymes and other biochemical compounds from plants. For this reason, the current paper investigates the main protein fractions and the phospholipids, from mulberry leaves harvested from the polluted Baia Mare area, compared with the mulberry leaves harvested from the control group Baneasa. The electric analysis revealed significant differences between the number of leaf protein fractions from heavy metals contaminated leaves ,compared to the leaves from the control group. Thin layer chromatography of phospholipids from the leaves showed the presence of lecithin only (phosphatidyl choline) which was not affected by lead contamination. In area polluted by heavy metals, plants of the genus Morus having a high absorption capacity for these chemicals, undergo qualitative changes of certain biochemical compounds in the leaf.
Keywords: lead contamination, gel electrophoresis, phospholipids, Morus sp.

Introduction

Heavy metals are chemical elements common to all soils, and their abundance in uncontaminated soils is between the range of percentages (iron, manganese) and the range of parts per million (copper, cobalt, lead) (Lăcătuşu R., 2004, Lixandru GH 2003). Due to soil contamination, the soil quality is reduced and the agricultural production is compromised, the consequences affecting the entire food chain, soil-micro organisms -plants-animals-humans (Budoi G., 2000). Baia Mare region's soils are full of lead-based toxic substances. Lead is a toxic metal that once entered into the body, accumulates in the liver, causing anemia, chronic Pb intoxication leading to nervous system disorders.

Researches in the field of remediation solutions for the soils contaminated with lead showed the possibility to cultivate plants with a high absorption capacity for the pollutants , including

mulberry tree (*Morus* spp.). But heavy metals may have undesirable effects on some biochemical compounds from plants, especially the proteins and enzymes. Therefore, in the present work we will emphasize the main protein fractions analysed by polyacrylamide gel electrophoresis SDS-PAGE from mulberry leaves harvested from polluted area of Baia Mare, compared with the control group harvested from Baneasa (SCSericarom Research Branch). The present work will also analyze some phospholipids like lecithin.

Material and methods:

Biological samples were collected from the mulberry trees from different locations (four areas) located in the polluted zone of Baia Mare. The number of locations depended on the nature of emissions, their quantity and size of land areas which they affected. The tests highlighted the major protein fractions by polyacrylamide gel electrophoresis SDS-PAGE, by comparing them with the control group at Baneasa, knowing that heavy metals negatively affect both qualitatively and quantitatively some biochemical components in plants.

● In order to extract leaf proteins, the following steps were performed: 100 mg above ground samples/ 50 mg roots samples were weighted, the samples were put in a mortar previously kept in the freezer, 5 ml of phosphate buffer was added and all the mixture was grinded for 2 minutes. Afterwards, the extract was placed in a centrifuge. The extract was kept frozen until it was used.

Dialysis: The defrosted samples were pipetted in the dialysis bag. The dialysis bag was placed in a dialysis buffer (phosphate buffer of 7.2 pH) in a Berzelius glass having a magnet. This operation was performed at a temperature of 4°C. Shaking lasted for 8 hours, and the dialysis buffer had to be changed every 2 hs. At the end of dialysis, the samples were proportionated in Eppendorf tubes and were frozen (at -45°C) until processing.

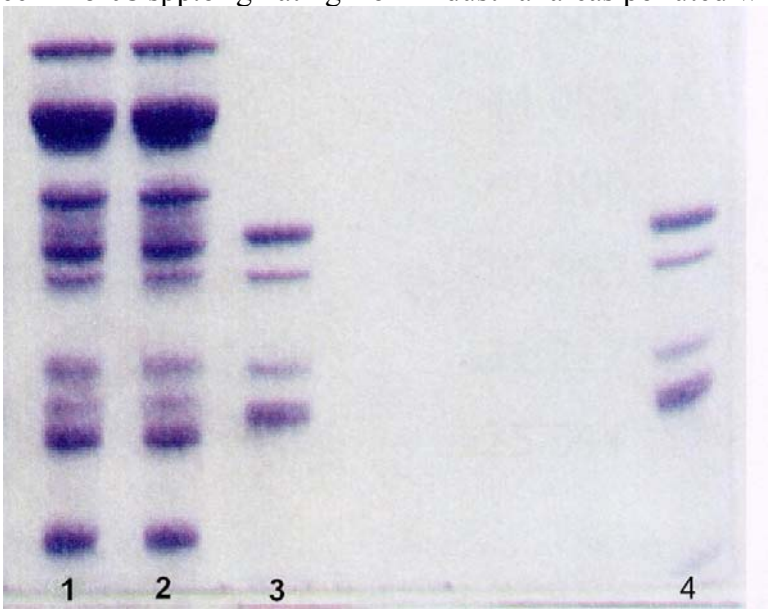
The analysis of protein fractions from the dialyzed extract through SDS-PAGE electrophoresis was done according to the technique described by Michalski (1996) and adapted as follows: 1 ml extract was diluted with 3 ml denaturated buffer and it was heated to 95 ° C for 4 minutes. For the migration, plates based on polyacrylamide gel were used, placed upright in the tank of the CONSORT E122 electrophoresis apparatus, Belgium. Dyeing was performed with Coomassie Brilliant Blue R-250 (Sigma). The following standards were used: bovine serum albumin 76,000 Da, ovalbumin 45,000 Da, 40,000 Da (?), cytochrome C 12,384 Da (?).

● Thin layer chromatography of phospholipids of mulberry leaf was performed on silica gel G (Merck), as described by Serban et al. (1993). The plates were activated 1 hour at 120 ° C and on them 3-5 ml of leaf lipid extracts was accumulated, obtained as follows: a homogenized leaf and chloroform - methanol (2:1, v / v) - mixture was filtered and the filtrate obtained was brought to the volume of 20 ml using the same extraction mixture; 0.7 ml of distilled water was added and slowly stirred, then left to rest two hours. Then the upper phase was removed and the lower phase was washed two times with a mixture of chloroform: methanol: water (3: 48: 47, v / v / v), creating the lipidic extract. As an irrigation solvent, a mixture of chloroform - methanol - water (70: 30: 5) was used; the phospholipids highlighting was realized by staining with iodine vapor.

Results and discussion:

In figure 1 we present the main protein fractions obtained from mulberry leaves harvested from the area polluted with lead.

Figure 1. The main protein fractions identified by electrophoresis SDS - PAGE of the mulberry tree - *Morus* spp.originating from industrial areas polluted with heavy metals (Ba



1, 2 = mulberry leaf protein fractions (genus *Morus*) in leaves collected from lead-polluted area of Baia Mare

3, 4 = Protein Markers

2, 3, 4 = leaf protein fractions of mulberry (genus *Morus*) – in leaves collected from Baneasa area - Bucharest

1, 5 = protein markers

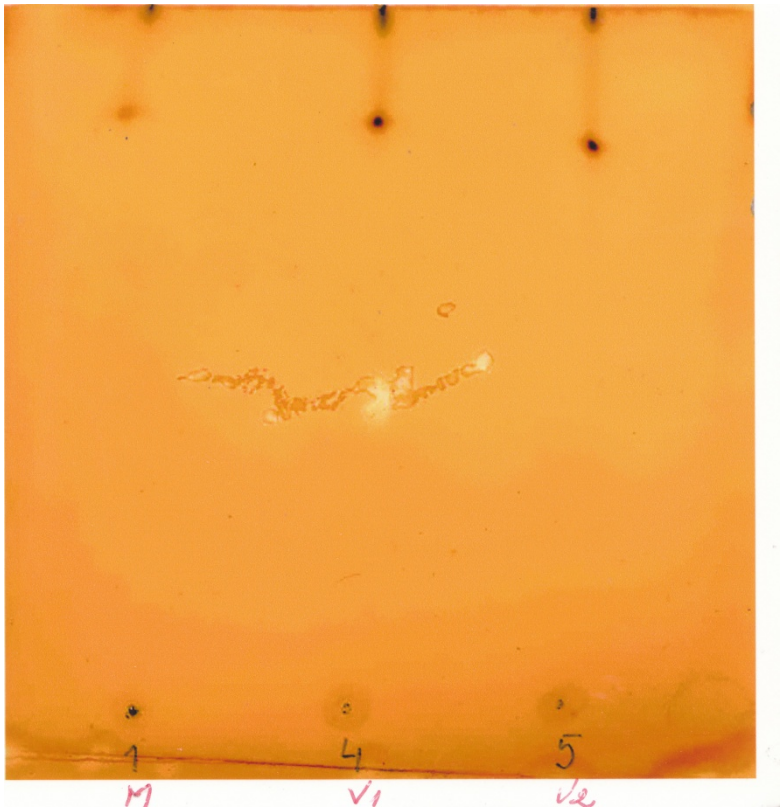
Figure 2. The main protein fractions identified by electrophoresis SDS - PAGE in the mulberry leaves- *Morus* spp.- collected from the control group in Baneasa

The electrophoretic analysis revealed significant differences between the number of leaf protein fractions from heavy metals contaminated leaves, compared to the leaves from the control group (Figure 2).

There is a major decrease in leaf protein concentration in the heavy metal contaminated group, compared to the uncontaminated one, reflecting into thepresence of only 10 major bands with molecular weights well-differentiated from 112,000 to 24,540 DaBetween these bands there are spaces that show the complete lack of some protein fractions that were found in the uncontaminated leaves, probably representing some of the enzymes that were inactivated by contamination or other denatured proteins.

This entitles us to conclude that in areas polluted by heavy metals, plants of the genus *Morus*, having a high capacity to absorb these chemicals, undergo qualitative changes in their leaves

The mulberry leaves collected from the Baia Mare were compared with the control samples collected from Baneasa. The main phospholipids were analysed. Chromatogram showed in all cases, the presence of lecithin) only, and it is well-known this is the most prevalent class of plant phospholipids. But the concentration of lecithin does not seem to be affected in the leaf harvested from Baia Mare area (Figure 3).



1 = control group
4, 5 = Baia Mare groups

Figure 3. The main phospholipids of mulberry leaf from the Baia Mare group compared with controls samples from Baneasa.

Conclusions:

1. Soil contamination with lead determines changes in the protein spectrum of mulberry leaves, (Morus spp.), found on such lands;

In areas polluted by heavy metals, plants of the genus Morus, having a high absorption capacity for these chemicals, undergo qualitative changes of certain biochemical compounds in their leaves.

2. In future research we intend to investigate the protein and lipid profile of several varieties of mulberry.

3. The concentration of lecithin (the most widespread plant phospholipid) in polluted mulberry leaf is not affected by heavy metal load.

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SECTION 2
SILKWORM BOMBYX MORI L.

2.1. SILKWORM REARING AND FEEDING

PRODUCTİON OF COLORED COCOONS BY FEEDİNG DYE ADDED ARTİFİCİAL DİET

By

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(POSTER)

The results of study on production of colored cocoons by feeding silkworms with dye added diets are summarized as follows. The proper amounts of dyes to 100g of diet powder were Rhodamine, Thionin 150mg, Neutral red 170mg, and N-Blue 200mg. With this amount of dyes

silkworms grew without physiological disorders. From the beginning of 5th instar, artificial diet was given to silkworms which were fed with mulberry leaves and dye added diets were given on 5th instar 4th day. Colored cocoon were produced by feeding silkworms with dye added artificial diet on 5th instar 4th day. Until 4th instar silkworms were fed with mulberry leaves and artificial diet was given from 5th instar. If the silkworms were fed with artificial diet from the beginning, they could also produce colored cocoons by feeding dye added diets were given on 5th instar 4th day. Pupation percentage and Single cocoon weight of colored cocoons were lower than control. Silkworm body, cocoon and egg showed the color of treated dye. The larval body color change started after feeding dye added diet. The dye induced color change was not inherited to next generation.

Keywords: Silkworm, Colored cocoons, artificial diet

EFFECT OF BIOSTIMULATOR ASMA-1 ON ECONOMIC INDICES OF MULBERRY SILKWORM

By

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To increase the mulberry silkworm productivity the researchers use biologically active compounds, which enrich leaf by protein and make it easily penetrable into the organism, since protein is urgent not only for the growth and development of the organism but also for the formation of economic indices and genitals of silkworms. Protein is attributed specific significance also for silkworm propagation - fecundation.

Mulberry silkworm is liable to various diseases especially in worm stage. Infectious diseases use to spread swiftly, they spread from a diseased to healthy organism and in some cases acquire mass character.

Proceeding from the above stated we decided to use a biostimulator Asma-1, as a biological additive to fodder to heighten and strengthen mulberry silkworm immunity and to elevate its economic indices.

On the base of the obtained results we can suppose that biostimulator Asma-1 exerts great influence on biotechnological characteristics of mulberry silkworm. As a result of action of its concentrated solution the cocoon and membrane masses, cocoon silk capacity and silkworm viability were increased. From four experimental versions of the biostimulator the 0,1% concentration solution turned out most efficient. As a result of application of the biostimulator Asma -1 in the worm phase the length of silkworm feeding period was reduced by a day, mulberry silkworm viability was increased by 1,0-1,2%, cocoon silk capacity was increased by 0,5-1,3%, raw silk thread yield - by1,9-2,0%, likewise cocoon yield per gram grain was increased by 0,2-0,4%

Keywords: Key words: mulberry silkworm, biostimulator, silk cocoon

METABOLIC STATUS OF ERI SILKWORM ON FEEDING TWO HOST PLANTS, CASTOR AND TAPIOCA AT DIFFERENT TEMPERATURES

By

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Abstract: A rearing experiment was conducted by feeding of Eri silkworms on the foliage of Castor and tapioca plant separately at different ambient temperatures i.e., 25° C and 20° C as the fluctuations in the temperature during rearing has tremendous influence on the eco physiology of insects that affect the cocoon commercial potentiality to a larger extent. In the present study the performance of eri silkworms corresponding to its energy levels and commercial potentiality of cocoons was comparatively analyzed by feeding two different host plants namely Castor and Tapioca. Various nutritional parameters such as food ingestion, faeces defecated, total food assimilated, total food oxidized and total food converted were analyzed by feeding of IV and V instar silkworms at 25° C temp. The study revealed that the growth and rearing performance of eri silkworms on the leaves of castor plant at 25° C temp exhibited the supremacy over Tapioca in the levels of food budget such as food ingestion, faeces defecated, total food assimilated, total food oxidized and total food converted indicating the impact of host plant variety on the growth and cocoon productivity of eri silkworms. The data revealed that the growth parameters such as larval duration, larval weight and nutritional parameters such as food ingestion, faeces defecated, total food assimilated, total food oxidized and total food converted, and cocoon characters such as no. of cocoons harvested, Cocoon wt., pupal wt., shell wt., shell ratio and dry shell wt. etc. differed statistically when eri worms are fed with castor foliage and tapioca leaves separately. This study has established that rearing at low temperature (20° C) severely affected the cocoon productivity.
Keywords: Eri silkworm, Castor, Tapioca, food consumption, assimilation and temperature

INTRODUCTION

Eri silkworm, Samia ricini is semi domesticated, polyvoltine and polyphagous in nature and feed, primarily, on castor (Ricinus communis) and Tapioca (Manihot utilisma) that form the secondary food plant Ericulture has been a traditional house hold activity and is largely confined to Northeastern states of India. However in the recent past the practice of eri rearing has spread to other states, like Karnataka, Tamilnadu, Gujarath and Andhra Pradesh. Uttar Pradesh holds immense potentiality for the tribal alleviating the poverty in semi arid areas and proved to be an important tool to generate an additional income for small scale, marginal farmers and back ward sections of the society through optimum utilization of eri food plants castor and tapioca cultivated by them.

The art of silk production is sericulture, an important cottage industry based on agro forestry earning foreign exchange worth 3200 crores per annum. Presently sericulture is being practiced in more than 60000 villages providing gainful employment, economic development and improvement in the quality of life to the people approximately 60 lakhs, most of them being small and marginal farmers. India has the distinction of cultivating all four commercially known

varieties of silk namely Mulberry, Tasar, Eri and Muga. The world raw silk production from mulberry and non-mulberry sectors is about 18480 MT, out of which mulberry silk industry contributes 16525MT , Tasar 428 MT ,eri 1485 and Muga accounts 117 MT.The production of non-mulberry silk in India has been increased from 1971 to 2010. In the beginning production of Tasar silk was more compared to eri and Muga silks. The production of Eri silk gradually exceeded over Tasar silk production from 735 MT to 1530 MT during 2008 to 2009 and India emerged as largest eri silk producing country and contributes 96% of total eri silk production in the world and Eri culture has become an important tool to generate an additional income for castor and tapioca growers and it has an immense potentiality for poverty alleviation in semi arid areas. The increase in the eri silk production in India from 735 MT to 1530 MT over a period of fifteen years clearly indicates its hold in development of eri culture in dry land areas of Andhra Pradesh. Apart from this Eri race was found to be a hardy race that sustain the diversified climatic conditions of this zone. Hence an attempt is made to study the impact of castor and tapioca, which are grown as border crop/ tuber crop respectively, on rearing performance of sericigenous eri silkworms at an optimum temperatures of 25° C and 20° C.

Of the different problems of ericulture, environmental factors are important for substantial productivity. The expression of cocoon characters such as No. of cocoons harvested, Cocoon wt, pupal wt, shell wt, shell ratio and dry shell wt. found to be varied with the change in the temperature. It is known that eri silkworms are exothermic in nature and the temperature has the direct influence on the physiology of insects including eri silkworms. The polyphagous habit, wild nature, acclimatization to hard climatic zones of dry lands, the availability of food plants etc. opened avenues for development of eri culture paving the alleviation of poverty. Also the potentiality of by products such as castor stem biomass, byproducts from rearing, nutritional status of eri pupae serves to produce base materials for small and marginal scale industries.

Keeping in view the above asserts, rearing of eri silkworm through standard techniques ensures high silk yields and eri culture can be practiced utilizing 30 to 40% of foliage from Castor and Tapioca plantations, without affecting the seed /tuber production respecting and ensures substantial additional income along with regular earnings to poor dry land farmers, besides providing gainful employment to the women folk also. Thus farmers need to be more informative and knowledgeable with regard to suitable host plant. Hence the preset study was taken up to highlight the suitable food plant for the eri silkworms in dry land areas.

MATERIALS AND METHODS

Rearing activities were experimented with 25 disease free layings each experiment was replicated five times @ 5 disease free layings per replication. The rearing was under taken as per the standard method advocated by Jayaprakash (2006). The temperature was maintained at 25° C ±1 and
20°C ±1. For assessment of cocoon productivity performance, data on Effective rate of rearing(ERR), cocoon weight, pupal weight, shell weight, shell ratio, cocoon number per kg, green cocoon harvest (by number and weight) was recorded. The statistical analysis of data was carried out as per the methods suggest by Fischer and Yates (1963). The host plant species selected were local variety of castor and tapioca. Tender leaves were fed four times a day up to third instars and semi mature foliage was fed five times to the IV and V instars respectively. Bamboo mountages, chandrike, plastic mountages were used for spinning of larvae (Petrusewicz and Mac Fadeyan, 1970).

The nutritional parameters were estimated by the method followed by Waldbauer (1968) and Delvi and Pandian (1972).The food and faeces defecated by the silkworm were weighed in an electronic single pan balance (Metler) to an accuracy of 0.01 mg. Faeces and foods were dried in an oven at 90^0 C till the weight constancy was attained. Consumption was determined by subtracting the dry weight of uneaten food from the dry weight of the food provided (Waldbauer, 1968). All faeces were separated daily at 6 AM from the rearing tray prior to first feeding and its

dry weight was taken as measurement for excretion. Dry food assimilated by the test individuals during the final instars was calculated subtracting the dry weight of the faeces produced from the dry food consumed. Assimilation of food was calculated by the method followed by Delvi and Pandian, (1972). The total amount of food converted into body substance was calculated by subtracting the dry weight of the individual before the experiment from the dry weight of the individual after the experiment. Food oxidized was calculated by subtracting the food converted from the food assimilated. Food utilization Budget of silkworms was studied using IBP terminology (Petrusewiez and Mac.Fayden(1970).

$$I = B + M + F,$$

Where I = Ingested food

F = Faeces (Undigested food + Excretory products)

M = Metabolized food (Assimilated food metabolized)

I- F =Assimilated food (Expressed in mg. dry weight except growth which is expressed in wet weight)

B = (I-F) Assimilated food used for growth

(Bio mass gained = Conversion, Delvi,1972.,Scriber and Slansky, 1981).

The data obtained for each parameter was analyzed for their significance, according to the method of Duncan's multiple range test (Duncan,1955).

RESULTS AND DISCUSSIONS

The results were shown in the tables 1 and 2,on feeding castor and tapioca to the eri silkworms. Observations were made on certain growth parameters such as larval duration, larval weight, commercial characters of cocoon such as number of cocoons harvested, Cocoon wt., pupal wt., shell wt., shell ratio and dry shell weight and nutritional parameters such as food ingestion, faeces defecated, total food assimilated, total food oxidized and total food converted at 25°C on foliage of castor and tapioca plants separately. Significant results were obtained for larval duration. Data revealed that minimum larval duration (19.45) of eri silkworm was recorded on castor plant at 25°C compared to larval duration on feeding tapioca (21.32) at 25°C. Similar results were observed even at 20°C temp. Castor effected shortest larval duration (23.9) compared to tapioca plant (24.99), at 20°C temp. Hence as far as the effect of temperature concerned at optimum temperature (25°C) the duration of feeding period was found to be short when fed on the foliage of castor plant. The results are broadly coincided with findings of Mishra (1986) who reported the duration of feeding period of larvae was 16 to 19 days when fed on different varieties of castor. Similarly larval weight (gm) was high in castor plants (7.41) at 25°C and minimum (6.71) in Tapioca at 25°C. Even at 20°C temperature castor exhibited more larval weight (6.01) and minimum weight (5.42) in tapioca. The variation in the temperature and

type of the food plant has influenced the larvae of Samia ricini by increased/ decreased cocoon characters (table: 2) such as number of cocoons harvested, Cocoon wt, pupal wt, shell wt, shell ratio and dry shell wt. etc. The ERR% of castor was high (88) than that of tapioca (84.13) at 25°C. Like wise high cocoon weight (3.56), pupal weight (3.02), shell weight (0.51) and shell ratio (14.67) were recorded in castor plant at 25°C. The cocoon commercial characters were decreased with tapioca at 25°C and 20°C temp when compared with those of castor plant leaves.

The Food consumption (food intake) was found to be higher in V instar in castor at 25°C compared to IV instar. In both instars the larvae exhibited maximum utilization without any post-moult fasting period as observed in other insects (Delvi, 1972). As far as the effect of food plant is concerned the utilization of food is comparatively higher in castor at 25°C in both instars. At 25°C, the food oxidized was more in V instar in castor plant. Similarly Food conversion values also followed the same trend as seen in the case of food assimilation. It is interested to note that any sudden drop in feeding or increase in feeding resulted in either decrease or increase in the assimilation efficiency. The results are in coordination with the findings of Naik (1965). The results from the temperature studies are in agreement with the results of productive performance of the eri silkworms. Harwod and Takate (1965) reported that the temperature influences the chemistry of metabolism in insects.

Based on the results it can be said that castor

was significantly superior over Tapioca. The results are strengthen by the findings of Attathom et al., (2002) who reported that castor effected the larval, silk gland and cocoon weights of Eri silkworms over tapioca. Hence from this study it was found that the nutritional status of food plant is very important parameter to be considered for larval growth, food utilization and there by expression of Cocoon characters for commercial potentiality. These findings are closely resembled with the findings of Daya shankar(1982), Devaiah et al.(1985) and Sakthivel(2004) who reported the superiority of castor over other food plants for larval and cocoon traits. The economic cocoon traits such as single cocoon weight and shell weight of eri silkworm were reported to be higher in castor over CO-2 variety of tapioca(Jayaraj,2004).These results were also in accordance with the previous results that the kind of host plant influences the growth and development in the insects(Reddy et al.,1989. Muthukrishnan and Pandian, 1987,Mariba Shetty et al., 1999 ,Rajashekhargouda et al., 2009 and Rajesh kumar and Gangwar, 2010).The figures clearly indicated the differences between the castor fed and tapioca fed eri silkworms.

The increased performance of eri silkworm on castor plant might be due to increased rate of food consumption, food assimilation and respiratory activity. This kind of increase in food consumption ultimately results in the increased performance of insects (Dey,1983). Dame (1972) reported the variations in nutrition and the level of metabolism would directly influence the rate of heart beat. Waldbauer (1968) and Delvi (1983) were of opinion that the high moisture percentage of the food plant as one of the biting factors that improves the food quality, leading to increased food utilization. Earlier findings support the results of the present study that the food consumption, accumulation of water from the metabolic food, causes the larval weight gain (Mariba Shetty et al.,(1999, Delvi et al., (1988) and Muthukrishnan and Pandian (1987). The increased activity of amylase of digestive juice and haemolymph of eri silkworm when fed on foliage of castor caused the increased food utilization and digestibility compared over other host plants (Saritha Kumari et al., 2008). The increased assimilation and oxidation of food might be caused because of better consumption of food and enhanced tranaminase activity of the intestine and hemolymph (Shyamala and Bhatt,1956 From these results it can be concluded that the castor is by far the best suitable host plantfor eri silkworm which grow luxuriantly and showed significantly increased the larval weight, energy levels due to maximum food consumption leading to increased protein synthetic activity and better cocoon production..

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TABLE: 1.Comparision in the levels of food budget of eri silkworms fed on Castor leaves and Tapioca at 25°C.

INSTAR→ PARAMETER↓	**IV instar 25°C.**		**V instar 25°C.**	
	CASTOR	**TAPIOCA**	**CASTOR**	**TAPIOCA**
Consumption	685.00a ±41.82	575.00b ±39.63 (-16.5)	3860.00c ±395.40	3240.90d ±360.02 (-19.3)
Excretion	240.00d ±26.92	220.75c ±24.98 (-8.02)	1925.00b ±151.23	1990.30a ±150.00 (+3.39)
Assimilation	455.00d ±28.39	359.25c ±26.23 (-22.19)	1935.00b ±146.36	1250.60a ±138.84 (-35.36)
Conversion	86.90d ±8.03	68.70c ±6.82 (-19.9)	160.00b ±18.20	146.90a ±16.90 (-8.75)
Oxidization	368.10d ±30.99	285.55c ±28.84 (-22.47)	1775.00b ±125.40	1103.7a ±114.38 (-37.85)

- Values are expressed in mg/wet wt./instar/larva.
- Each value is a mean of eight estimations.
- Percentage increase (+) / decrease (-) relative to optimum temperature is given in percentages.
- ± Standard deviation
- Means followed by the same letter in a row do not differ significantly.

TABLE:2 Productive performance and commercial characters of eri silkworm fed on castor and tapioca leaves at different ambient temperatures.

PARAMETERS	25°C Temp.		20°C Temp.	
	CASTOR	TAPIOCA	CASTOR	TAPIOCA
Larval Duration(days)	19.45a ±0.087	21.32b ± 0.132	23.9c ±0.311	24.99d ±0.005
Larval weight (gms)	7.41d ±0.032	6.71c ±0.097	6.01b ±0.147	5.42a ±0.543
Good Cocoons Harvested (%)	93.00d ±0.08	84.13c ±0.523 (-9.5)	82.13b ±0.135 (-13.2)	76.12a ±0.237 (-18.15)
ERR%	88.0d ±0.57	81.0c ±0.241 (-7.0)	74.56b ±0.077 (-15.2)	67.02a ±0.320 (-26.2)
No. of cocoons /Kg	378d ±0.003	339c ±0.174 (-10.3)	320b ±0.582 (-15.3)	290a ±0.174 (-23.2)
No. of green cocoons	22001d ±0.094	18748c ±0.009 (-14.7)	16140b ±0.135	12420a ±0.750
Wt. of green cocoons	71.912d ±0.097	63.840c ±0.605 (-11.2)	61.145b ±0.182 (-14.9)	59.840a ±0.356 (-16.7)
Wt. of dry shells	15.62d ±0.089	14.00c ±0.232 (-10.3)	9.930b ±0,075 (-36.42)	8.812a ±0.215 (-43.5)
Cocoon Wt.(gms)	3.56c ±0.60	3.00b ±007 (-15.73)	2.98a ±0.292 (-16.2)	2.67a ±0.193 (-25.8)
Pupal Wt.(gms)	3.02d ±0.012	2.56c ±0.521 (-15.2)	2.45b ±0.564 (-18.8)	2.01a ±0.883 (-33.4)
Shell Wt.(gms)	0.51d ±0.009	0.44c ±0.051 (-13.7)	0.40b ±0.490 (-21.5)	0.299a ±0.200 (-41.3)
Shell Ratio	15.67d ±0.311	14.15c ±0.062 (-3.5)	13.90b ±0.189 (-5.2)	13.45a ±0.854s (-8.3)

- Values are expressed in mg/wet wt./instar/larva.
- Each value is a mean of eight estimations.
- Percentage increase (+) / decrease (-) relative to optimum temperature is given in percentages.
- ± Standard deviation
- Means followed by the same letter in a row do not differ significantly.

APPLICATION OF BIOLOGICAL METHOD IN MULBERRY SILKWORM FEEDING TECHNOLOGY

By

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Biotechnology of silkworm feeding implies not only the effect of ecological factors on silkworm, and selection of food rich in protein and fats but also selection of various biological admixes for elevation of silkworm viability and increase of food nutritive value.

Biostimulator Asma-1, as antibacterial preparation, improves immunity of live organism. It possesses the selective ability in exercising its effect on the cell – to suppress the increase of cells that are infected by bacteria and viruses. It contributes to the process of protein synthesis in a silkworm, while active synthesis of proteins provides for the increase of silk mass and silk capacity of the final product.

The effect of action of the above referred preparation was tested in grain phase. Experiments were performed on the mulberry silkworm breeds Mziuri-1 and Mziuri-2 which are distinguished by their thread length (2500-3000m) and fineness (1,56 tex), but this thread is characterized by relatively low viability which needs further improvement. This is namely the reason why we gave preference to Asma-1 in our experiments and the grain of the above referred breeds was treated in it with the goal to elevate silkworm immunity-resistance to diseases. As a result, silkworm viability was increased by 1,1-1,3%, cocoon silk capacity – by 0,6-1,9%, raw thread yield – by 1,13-2.81%.

Biostimulator Asma-1 contributes directly to the growth of worm mass and silk gland mass. There is a direct relation between the silk gland mass and cocoon silk volume, the more the silk gland mass the higher the cocoon silk capacity. To evaluate the effect of biostimulator on mulberry silkworm viability we used the following biological characteristics: feeding duration, silkworm viability, cocoon yield and in case of treating of the grain in biostimulator - grain vivification index.

In our experiments, when grain was subjected to treatment in this bio-stimulator, the best results with the view of embryo and post-embryo viability, cocoon silk capacity and raw thread yield, the best results were obtained in case of the grain treated in 0,1% solution. When treated in the same concentration, the data of the breed Mziuri-1 turned out better than Mziuri-2 according to the cocoon mass and silk capacity, as well as the raw thread yield.

Keywords: mulberry silkworm, biostimulator, silk cocoon

SILK GLAND AND SILK MASS RATIO ACCORDING TO SILKWORM GENDER

By

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There is a direct correlative link between the silkworm silk gland mass and cocoon silk capacity. The greater the silk gland mass, the higher cocoon silk capacity.
Silk gland mass differs according to silkworm breeds and hybrids and respectively the ratios of the silkworm mass and silk gland differ.
Experiments were carried out on Georgian silkworm breed "Mziuri-2", length of thread of which equals to 2500-3000 meter. Silkworm body and silk gland masses are gradually increasing from the third day to the eight one of the fifth instar. Initially the ratio of "Mziuri-2" silk gland mass to body mass equaled to 8,0 and 9,3%. According to the experiment results by the end of the fifth instar the silk gland mass increased 4-7 folds and it formed 22,3% of the silkworm body mass in male silkworms, while in female worms – it formed 29,2%. Increase of silk gland mass was expressed in cocoon silk capacity, which correspondingly was increased from 22,1% to 25,0 %. Silk gland suffers changes together with the silkworm growth and development. The cocoon silk capacity rate depends on the intensity of silk gland growth and silk synthesis.

Silk gland size and mass depend on the silkworm breed and its instar. At about 70% of the mass is formed thanks to assimilation of proteins received from mulberry leaf, while 30% - via the synthesis of silkworm hemolymph and mulberry plant proteins. Certain portion of protein (at about 15%) is formed in silkworm body in the process of cocoon making that is, when silkworm doesn't receive food.
Keywords: mulberry silkworm, silk capacity, protein

ALTERATION OF QUANTITY AND QUALITY CHARACTERISTICS OF MULBERRY SILKWORM IN UNFAVOURABLE CONDITIONS

By

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The present paper considers the results of influence of fodder quality, norms and feeding season on the data of alteration of quantity and quality characteristics of mulberry silkworm. Lately, as a result of extreme pollution of environment and exhaust of great quantity of toxic components to environment the nutritive value of mulberry plant leaf suffered significant deterioration, which made definite negative effect on the indices of genetically formed characteristics of mulberry silkworm breeds. It was proved that in case of feeding of mulberry silkworm in unfavourable conditions both quantity and genotype indices inherent to silkworm breeds, such as correlation and hereditary coefficients, which are used for determining the efficacy of selection, suffer changes. In case of autumn feeding we observed a decrease of cocoon membrane mass (h^2_R = 0.43 – 0,32) compared with that of spring feeding (h^2_R = 0,57 -0,50) while the silk capacity decreased to h^2_R =0,47 – 0,36. Families of such high productive breeds which for years were characterized by high bio-technological indices, in unfavourable conditions showed sharply

reduced indices, which made negative effect on the selection efficacy. In case of increase of the fixed ration of fodder by 20 %, mulberry silkworm viability was heightened by 0.9%, mean weight of a cocoon was increased by 4,8%, silk capacity – by 1,8% and cocoon yield per kilogram given to silkworm leaf – by 8,6%.
Keywords: mulberry silkworm, selection, silk cocoon

IMPACT OF SAMPOORNA – A PHYTOECDYSTEROID ON THE REARING PERFORMANCE OF ERI SILKWORM *SAMIA RICINI* (DONOVAN), SATURNIDAE

By

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Eri silkworm *Samia ricini* (Donovan) the only domesticated non mulberry multivoltine, reared indoor, is a polyphagous in nature and feeds primarily on foliage of Castor (*Ricinus communis*) and Kesseru (*Heteropanax fragrans*). The critical problem encountered by rearers is non uniform maturation process for cocooning of eri silkworm larvae especially during winter season where in the mounting process extends up to 3-4 days. To overcome the major problem of Eri silkworm rearing the phytoecdysteroid hormone extracted from the plant of Caryophyllaceae by Kanika Trivedy (2003) named Sampoorna was tested. The test results revealed that Sampoorna doses 50 and 75 mg/lit hasten the 100% maturation by 36 hours against 72 hours in control in winter. In rainy season 100% larval maturation was recorded in PE treated batch by 30 hrs and 54 hrs in control. In summer for complete maturation the difference between treated and control is 18 hours without sacrificing the commercial characters,i.e cocoon weight, shell weight and shell ratio.
Keywords: Eri silkworm, Phytoecdysteroid, uniform maturation

2.2. SILKWORM GENETICS AND BREEDING

PRESENT BREEDING STATUS AND MAJOR CHARACTERISTICS OF KOREAN AUTHORIZED SILKWORM RACES

By

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(POSTER)

The first standard criteria for silkworm breeding test and authorization of leading varieties were established in 1964 to provide higher confidence and data comparison between private breeding organization and foreign research centers. This means that no systematic silkworm test standard or criterion was existed for 60 years since Korean sericultural researches began in 1900. The new regulations on authorization and supply of leading silkworm varieties were enacted in 1972, because it was necessary to retest periodically the leading silkworm varieties. The regulations, referred the qualification, designation and abolition of authorized silkworm races, became the foundation of domestic substantiality of Korean silkworm breeding and raising public confidence of Koran race in foreign policy. After the establishment of this Sericultural regulations, 32 domestic authorized silkworm races were bred and supplied and 7 races for spring rearing, 3 races for summer and autumn rearing, and 5 races for spring/autumn rearing, totally 15 races are being supplied in present.

The goal of silkworm breeding is being changed according to the request by the time. The golden age of cocoon production in Korea was the period between late 60s and mid-70s, and the breeding goal was developing varieties with high silk yielding ability. During the period of late 1970s and 1990s, the silkworm breeding was focused to the sex-limited varieties, strong and healthy races with high cocoon quality, and strains suitable to artificial diet, because the labor cost was rising up due to country's rapid industrialization.

The present breeding goals since 1990s is aimed to breed varieties suitable for functional products with special use, for example, varieties with very thin cocoon filament, high quality raw silk, big and fat body for silkworm powder manufacture, naked pupae for cordyceps production, sex-limited strains for easy sex identification, yellow silk producing strains, and yellowish green strain.

For the development of strains appropriate to special uses, we introduce various genetic resources for breeding strains proper to the special purposes and continue researches for breeding new high value-added silkworm strains and developing new uses of silkworms.

CHOICE OF PROSPECTIVE FAMILIES OF MULBERRY SILKWORM BY THE USE OF SELECTION DIFFERENTIAL AND HEREDITARY COEFFICIENT

By

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The present paper deals with the results of efficient selection of mulberry silkworm according to silk capacity index in one generation. It is known that in the process of selection work we often come across the cases when we fail to fix characteristics in further generations in desired direction which hinders the process of rapid obtaining of new breeds. Therefore, for the improvement of the economic indices of the existing breeds and for leading adequately selection activity of mulberry silkworm and for speeding up the process, we have used mathematical parameters, selection differential and hereditary coefficient.
The experiment was carried out on 200 families of mulberry silkworm breeds: "Digmuri-6" and "Digmuri-7", and 12 families of the breed "Digmuri-6" and 17 families of the breed "Digmuri-7", which were characterized by high silk capacity and productivity capacity were picked out according to selection efficiency. Worm viability of these families equals to 98%, live cocoon silk capacity reaches 25%, while cocoon membrane mass varies within the limits of 0,550-0,600 g, This is namely the path the selection activity will be continued to obtain highly productive breeds.
Keywords: mulberry silkworm, selection, selection differential

FOCUSED APPLICATION OF MULBERRY SILKWORM SEX IN SERICULTURE AND ITS ECONOMIC EFFICIENCY

By

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Efficacy of sericulture as such, alongside with other factors, depends both on breeding of highly productive breeds and hybrids of mulberry silkworm and their inculcation in practice, as well as on purity of industrial hybrid grain. Currently available technological regimes can not provide preparation of pure industrial hybrid grain, since at industrial conditions accurate separation of breeds according to sex and accurate choosing of components to be crossed, can not be managed,

which, in its turn, conditions contamination of hybrid grain. The generation obtained from such grain is characterized by non-homogeneous development, decreased viability and low productivity. Search of more precise rules for division by sexes led the researchers to the elaboration of a method of genetic marking of mulberry silkworm and to sex regulation through biological way.

Work in this direction was commenced in Georgia after the 80's of the last century. Female selection material obtained via radiation selection was used as starting material. W_2 gene of female mulberry silkworm of this material was characterized by translocation ability, while the male gene had no pigmentation capacity of grain serous membrane cell. As a result of many years hard selection work the researchers obtained two breeds labelled in grain phase, Tao-1 and Tao-2, female grain of which is black, while the male grain is white. The major indices of the above referred breeds are as follows: length of silkworm feeding -28 days, worm viability -97%; mean cocoon weight 02,25 g; cocoon yield per gram worm – 4,95 g; silk capacity – 24,0-25.0%; thread length -1522-1600 m.

As a result of spreading of the above referred breeds in industry we'll avoid the most complex and laborious procedure of division in sexes in the process of hybrid grain preparation. The obtained product (hybrid grain) will be of 100% purity (instead of 50%) and it will increase twofold the grain yield which will result in a decrease of the self cost of the prepared product, thus creating real terms for realization of grain abroad.

By spreading only male grain in farm economies natural silk productivity will be increased by 10-15%, quantity of leaf for silkworm feeding will be cut down and viability of male worms will be increased significantly in all stages of development. And it, finally, will result in the increase of the yield of the obtained product by 20%.

Keywords: mulberry silkworm, selection, gene

RESULTS OF POLISH AND FOREIGN BIOTYPES OF MULBERRY SILKWORM (*BOMBYX MORI* L.) BREEDING IN POLISH CONDITIONS

By

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(POSTER)

The aim of proposed poster is to present results of breeding season 2010 of Polish, Romanian, Japanese, Chinese and Georgian varieties of mulberry silkworm (*Bombyx mori* L.). The index value of studied varieties was calculated and compared. The purpose of our study is selection the most stable biotypes for obtaining new industry hybrids with the best features.

Keywords: mulberry silkworm, index value, biotype, sericulture

FIBROIN CONTENT IN THE SILK SHELL IN SILKWORM, *BOMBYX MORI L* BREEDS OF JAPANESE TYPE

By

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(POSTER)

The percentage content of fibroin in the silk shell in 73 silkworm breeds of the Japanese type from the national germplasm of Bulgaria has been studied. It was detected that the fibroin content was the lowest in the breed Mziuri 2 with origin from Georgia – 67.86 % and the fibroin content was the highest in the breed A 14 – 76.57 %. This is the first fibroin content investigation conducted in Bulgaria in so big number of silkworm strains. As a result of it some recommendations regarding the usage of suitable silkworm breeds of the Japanese type as initial material for the breeding work aiming at creation of both lines characterized with high and low fibroin content in the silk shell were made.
Keywords: Silkworm, Bombyx mori L., Fibroin, Silk, Breeding

SILKWORM PARTHENOGENESIS: PHENOTYPIC INTRACLONAL VARIABILITY

By

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(POSTER)

B.L. Astaurov discovered silkworm cloning by thermal parthenogenesis of the eggs dissected from the ovaries (1936). By 1972, several clones had been selected in which complete embryogenesis can be induced in nearly all unfertilized eggs obtained either from ovaries left in situ or from the ovaries transplanted into another host. Ovary transplantations provide excellent tool for revealing the impact of host genetic milieu on the development of progeny. In our study we transplanted ovaries from the mono-voltine parthenogenic clone P29 into the male and female hosts of monovoltine non-parthenogenic line S-5. Ovaries were transplanted at different larval stages. As many as 72% of more than 2500 hosts survived, and eggs developed in 64% implanted ovaries. Progeny obtained from the dissected eggs was followed until the imaginal stage and in some cases for several generations. The genetically determined donor capacity for parthenogenesis was maintained in clones derived from ovary transplants (transplantational clones, TC). Several clear effects on TC phenotype were observed when ovaries developed in the male hosts (TCM), while progeny from the ovaries grown in the female hosts (TCF) retained all phenotypic features of the donor clone P29. Affected features included heterozygous donor loci that determine black body coloration of the 1st instar larvae and yellow pigmentation of the cocoons. Attenuated expression of the dominant alleles in TCMs is evident from the reduction of

black body coloration of the 1st instar larvae and from the lighter cocoon pigmentation. The degree of coloration depends on the egg positon in the ovariole: more apically situated eggs give darker colors than the distal ones. The lightly colored larvae of TCM (about 30% of the progeny) were prone to die in the 1st instar (85% mortality rate), while the dark ones completed development into imagoes. The ovarian development in males also led to production of exclusively non-diapause eggs, a feature that never occurred spontaneously in either the donor or the recepient silkworm strains. It must be stressed that all deviations from the donor phenotype appear as temporary modifications and are not transmitted to the next clonal generations. The mechanisms of these host effects in TCMs have not been explained. We suggest that they depend on a gradient of morphogenetic substances along each ovariole. Preliminary studies (2010) suggest that an "ovogenetic gradient" can be the basis of intraclonal variation in penetrance and expressivity of the genes that determine the formation of pigment spots in the larvae. It had been shown in different clones that maximum expressivity can be reached by a simple increase of the egg incubation temperature (1980). Studies on the control of intraclonal variation have both theoretical and applied biotechnological aspect.

This study was in part supported by project P502/10/2382 of the Czech Science Foundation.
Keywords: parthenocloning, the silkworm, clone, ovary transplantation, egg thermoactivation, oogenesis, parthenogenetical progeny, diapause, phenotypical intraclonal variability, heterozygosity

ON A NEW SUBSPECIES OF *ANTHERAEA MYLITTA* FROM INDIA

By

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A new sub species *Antheraea mylitta indica* has been reported, described and biosystematics is given for the first time from India . The characters wing curvature, ocellus, cocoon and genitalia are different in the species than that of closely related 44 eco- races of *A. mylitta* from India. No sub species of A *mylitta* has been visualized previously from the world.
Keywords: New sub- species, *A. mylitta indica*, description

A STUDY ON DOUBLE COCOONS GENERATIONS PRODUCTIVITY IN THE BOMBYX MORI L. DOUBLE CROSSE

By

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(POSTER)

The study aimed to investigate the possibility for using double cocoon generations as a parents for creation of Bombyx mori L. crosses.
Two variants of silkworm B. mori L. double crosses was created : control in which parents originated from normal cocoons and experimental group – from double cocoons.
It was found that the generations originated from double cocoons posses a high biological potential and demonstrated higher value of main technological characteristics in comparison with generations originated from normal cocoons.
Considering the results obtained from the present study, we confirm and recommend double cocoons application for industrial silkworm seed production.
Keywords: *Bombyx mori L,* Double cocoons, Crosses, Biological, Technological characteristics

NON-DESTRUCTIVE DETERMINATION OF SEX OF *BOMBYX MORI L.* PUPAE AND SOME TECHNOLOGICAL PROPERTIES OF COCOONS BY NEAR-INFRARED SPECTROSCOPY

By

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(POSTER)

Raw silk quality is known to be largely depending on the cocoon properties. Determinations of cocoons' technological parameters are destructive and time consuming. Fast and reliable methods for in-vivo analyses of cocoons are highly desirable. The objective of this study is to investigate the possibilities for non-destructive detection of sex of pupae and some technological properties of cocoons by NIR spectroscopy.
A total of 80 univoltine F1 hybrid cocoons - population of interbreeding 1013x1014 were used in the study. Rearing of the silkworm (*Bombyx mori L.*) was conducted during may-june 2007 in the experimental training base of the Faculty of Agriculture, Trakia University, Stara Zagora by standard rearing technique. Single cocoon reeling was carried out. Several technological parameters - Filament weight, Filament length, Cocoon shell weight, Shell ratio and Silk ratio were determined. Additionally sex of pupae was determined.
NIR measurement was performed with the NIRSystem 6500 using the transmittance mode and wavelength region from 600 to 1400nm were used in an investigation. A commercial program Pirouette 2.0 (Infometrics, Inc., Woodinville, WA, USA) was used for performing of spectral data processing. PLS regression was used for quantitative analysis and SIMCA for qualification.
High accuracy of classification of pupae according of their sex was obtained. Recognition accuracy achieved was 96% correct classification. The results for quantitative determination showed an existing relationship between spectra of cocoons and their technological parameters.
The results indicated that NIR spectroscopy had the capability for fast and non-destructive in-vivo cocoons quality evaluation.
Keywords: *Bombyx mori L,* Near-infrared spectroscopy, Sex, Technological properties

2.3. SILKWORM PATHOLOGY

TEST IN OF ASCORBIC ACID AGAINST NUCLEAR POLYEDROSIS OF A SILKWORM

By

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As a result of the researches spent at Institute of the Sericulture was established the efficiency of different concentration of ascorbic acid in different phases of disease of a silkworm- nuclear polyedrosis . In case of silk-worm eggs processing in 0,05 and 0,01 % of an ascorbic acid solution during 30 and 120 minutes grows the exit of larvas . Also is established that viability of caterpillars increases on 2,7-5,5 % and the quantity of diseased caterpillars decreases on 23,1-50,9 %.

Preparation was tested for a silk-worm eggs and a silkworm in different concentration and an exposition. Is received an interesting data, in particular, in the silk-worm eggs processed by a preparation under normal conditions a feed of caterpillars, the quantity of the diseased caterpillars decreases to 75-100 %.Increases an exit of larva's on 2,7-5,5 % and falls the level of sickness (to 22,5-77,5 %).

Keywords: Mulberry silkworm, disease, biostimulator

STUDY OF FEASIBILITY OF APPLICATION OF BACTERIAL PHAGES AGAINST MULBERRY SILKWORM BACTERIAL DISEASES

By

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One of the hindering factors for mulberry silkworm productivity is bacterial diseases. Sesphage and Encophage might be used against bacterial diseases. They enable us to decrease bacterial disease in the process of silkworm feeding. Positive effect of bacterial phages is expressed in cocoon yield, its quality, silk capacity and thread length. We were the first who investigated the feasibility of application of bacterial phages against bacterial diseases of mulberry silkworm at the Scientific-Research Institute of sericulture of Georgia (Caucasus).

Keywords: mulberry silkworm, bacterial diseases, application of bacterial phages

Introduction. Mulberry silkworm bacterial diseases (bacterioses) are widely spread in nutrition period and in a short time they ruin 25-30% of the already fed worm. Bacteriosis

decreases sharply mulberry silkworm viability and productivity [1]. A great attention is paid to struggle against mulberry silkworm bacterioses [2.3.4]. Traditional methods of the struggle against bacteriosis include observance of sanitary-hygienic and feeding conditions, isolation of resistant genotypes, phyto - and antibiotic therapy.

Gradually cultures resistant to antibiotics were formed in the nature, which conditioned the therapeutic effect of antibiotics and often made antibiotics useless. Therefore it became necessary to look for their substitutes. One of such substitutes is the bacteriophage.

Bacteriophages are widely spread in the nature. Bacteriophage is a virus, which possesses its own hereditary material. One and the same form bacteria can be a host of various forms of phages. Our study planned to prove the feasibility of application of bacteriophages against bacterial diseases of mulberry silkworm. With this in view, we are the first in Georgia who carried out investigations in this direction at the Institute of Sericulture of Georgian Agrarian University and at the G. Eliava Institute of Bacteriophage, Microbiology and Virology [5].

Material and methods: Mulberry silkworm varieties Mziuri-1, Mziuri-2 and Mziuri-5 were used as a material for investigation. These varieties are characterized by perfect technological indices of cocoon and by low immunity against bacterioses. In case of artificial infection is enough to 200-300 bacteria/worm [7]. The experiments were carried out on the naturally infected mulberry silkworms, which were infected with *Enterococus, Coccu, Bacillu, Bacillus subtilis.* Silkworms were given leaf on the basis of the observance of agro-rules [6]. In the process of experiment, hydrothermal regime was recorded and regulated in the premises where silkworms were kept. Phage preparations were performed at the G.Eliava Institute of Bacteriophagy, Microbiology and Virology.

In each case was taken three replications, 100 worms in each one, in total there has been testing 300 copies of worm in one variant. In the table and graphic there is presented average arithmetic of the three replications.

We used sesphage and encophage against mulberry silkworm bacterioses. In the body of the second-instar worm phages were introduced as follows: soft leafs were placed in closed glass vessel and a phage solution was added in the amount which ensured good impregnation/wetting of all leaves (photo 1 –a, b). We mixed the material thoroughly, spread it on a sheet of paper and dried it on the open window till it lost specific smell (photo 2). Silkworms which were left hungry for 12 hours were given phage-treated leaf, by double meal a day, with 4 hours interval.

a.

b.

photo1. a. Pouring of phage containing solution; b. Impregnation of leaves

Photo 2. Drying of leaves

Results and discussion. Nutrition period in all variants lasted up to 35 days. In the case of the variety Mziuri-1, in the version with phage-treated leaves, virus and fungous diseases increased, while bacterial diseases were not revealed. We observed a combined infection: NPV and bacterioses, where, compared with the control, in the version treated with the phage, it was decreased (Fig. 1).

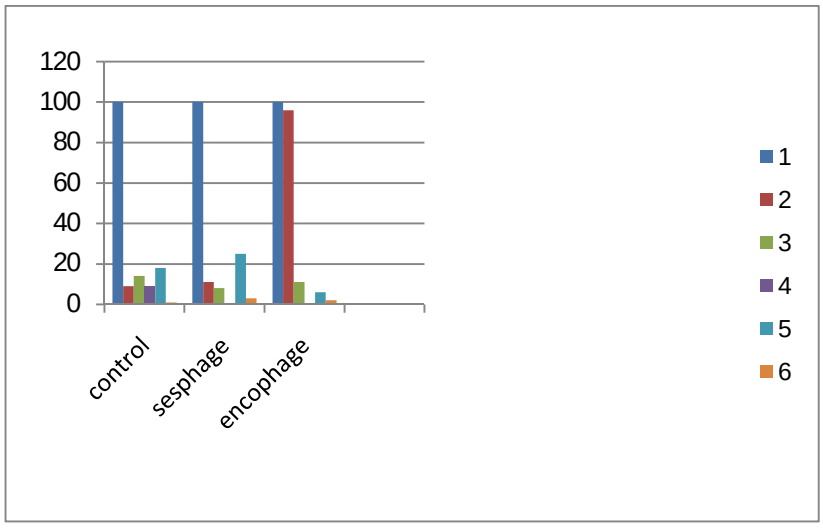

Fig 1. Variety "Mziuri-1"

Starting number of silkworm; Nuclear polyhedrosis;

Nuclear polyhedrosis+bacteriosis; Bacteriosis;

Muscardine; Pebrine;

Sesphage and encophage affected worm viability: in the case of the variety "Mziuri-1" worm viability increased by 30-31% compared with the control, in the case of encophage it increased by 20% and decreased in the case of sesphage by 1% in the case of variety "Mziuri-2". Treatment of the leaf with the phage did not affect variety "Mziuri-5".

In the naturally infected mulberry silkworm, healthy cocoon % increased in the phage-treated variant, it decreased by 12,5% in variety "Mziuri-2" in the case of sesphage. Weight of raw cocoon per unit slightly increased, compared with the control. Quantity of defective cocoon decreased in the phage-treated variant in the case of variety "Mziuri-2".

Raw cocoon and cocoon shell weight were law in the control batch, which conditioned silk production. These indices were increased especially due to the action of encophage (Table 1).

Phage treatment made positive effect on cocoon filament weight of all three breeds. It increased from 3% to 10% in the phage-treated batch, compared with the control.

In the case of the variety "Mziuri-5" filament denier increased from 1 to 8% due to the action of sesphage and encophage. In the case of variety "Mziuri-2" filament denier decreased by 17-20%, while in the case of "Mziuri-1" only encophage treatment resulted in the decrease of the filament denier

On the basis of our data the following conclusions could be made:

1. Effect of sesphage and encophage depends on mulberry silkworm genotype.
2. Sesphage and encophage contributed to the increase of silkworm viability and the decrease of bacterial disease cases by 25-17%.
3. Phage treatment positively affected cocoon quantity, cocoon shell weight and filament denier.
4. Application of bacteriophages against bacterial diseases of mulberry silkworm is ecologically safe and could give good perspectives.

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Table 1

Effect of sesphage and encophage on biotechnological characteristics of naturally infected mulberry silkworm varieties

Variant	Mulberry silkworm variety	Silkworm viability, %	Normal cocoon, %	Defective cocoon, %	Raw cocoon		Cocoon shell weight		Silk capacity %	Silk Filament wength, %	Silk Filament weight, %	Remainder weight, %	Filament denier, %
					g.	%	mg	%					
Control	Mziuri-1	29	10.1	100	1.13	100	206.6	100	18,3	100,0	100	100	100,0
Sesphage		59	31.9	220	1.21	107	269.3	130	22,3	102,0	101	96	100.3
Encophage		60	40.6	126	1.31	115	274.6	132	21,0	102.6	146	126	70,0
Control	Mziuri-2	73	48.9	100	1.33	100	289.5	100	21,8	100,0	100	100	100,0
Sesphage		72	36.4	79.4	1.35	102	260.4	89	19,3	90,0	108	107	83,0
Encophage		93	60.6	58.8	1.44	108	278.3	96	19,3	93,0	103	68	90,0
Control	Mziuri-5	84	5.0	100	1.53	100	288.0	100	18,8	100,0	100	100	100,0
Sesphage		23	8.5	60.7	1.52	99	290.3	140	19,1	111,0	102	108	109,0
Encophage		72	34.0	125	1.56	102	292.0	101	18,7	101,0	101	136	100.7

SECTION 3
SILKWORMS AS BIOLOGICAL MODELS

OBTAINING AND ANALYSIS OF PROTEIN HYDROLISATES FROM LOCAL RAW MATERIALS

By

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Protein hydrolysates are broadly used for parenteral feeding, for correction of incomplete protein and allergen-free feeding, as well as in microbiology, as polyfunctional medical and preventive remedeties, as immunomodulatory components in biologically-active additives, antioxidants, flavor additives, in cosmetics and for others purposes.
The some of potential protein products, wastes of agriculture and food industry are tested in present study. Among them are: nonutilizable at present blood of agricaltural animals and its components, gelatin, lacto serum, baker's yeast, proteins of cotton and soya cake, silk fibroin and sericin and other protein materials and waste. Simultaneously we solved a problem of wastelessness.
In the work we used chemical and enzymatic methods, as well as autolysis of protein products. For increasing of efficiency of acidic or alkaline hydrolysis we used the surplus pressure in the media, preventing oxidation and destruction of hydrolysis products. Then the hydrolysates was cooled down, neutralized and evaporated.
Fractionation, analysis and specification of hydrolysis products were realized by ultra-filtration, dialysis, gel-permeation chromatography, paper and thin-layer chromatography, as well as by spectrophotometry .
As a result of the study, using earlier improved method of natural silk proteins hydrolysis we have found optimal conditions for efficient hydrolysis of studied protein materials of vegetable and animal origin to obtain products mixture (peptides and amino acids) with biological effect. It is shown also that hydrolysis in close to physiological conditions, with use of autolysis and (or) enzymes gives higher output of native products.
The obtained products of hydrolysis were compared by physico-chemical characteristics with similar Russian preparations (baker's yeast autolysate "Aleksandrina") and with Chinese and South Korean preparations of silk fibroin hydrolysates, as well as with other commercial preparations of protein hydrolysates. Protein hydrolysates obtained by proposed method did not yield to foreign analogues by its characteristics. For example, fibroin hydrolysates obtained in the present work did not require the additional purification. At present these and other characterized hydrolysates are tested in composition of artificial diets as biostimulator

of development and productivity in biotechnology of insects and biopesticides of last generation.

Keywords: protein, chemical, enzymatic, hydrolysis, wastes, soya, cotton, sericin, fibroin, analysis.

PHYLOGENETIC DIFFERENTIATION OF SILKWORM (*BOMBYX MORI* L.) STRAINS WITH DIFFERENT ORIGIN RAISED IN BULGARIA

By

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(ORAL PRESENTATION)

Abstract: Ten diverse strains of the silkworm *Bombyx mori* L. with various origin were analysed using hemolymph nonspecific esterase polymorphism. The allele frequencies, the average number of alleles per locus, the percentage of polymorphic loci, the observed and expected heterozygosity, genetic distance by Nei and the fixation index by Wright (F_{ST}) were calculated through the BIOSYS-1 program. The average number of alleles per locus varied from 1.3 to 2.5. The degree of polymorphism ranging from 100% to 25% with heterozygosity value of 0.392 - 0.083. The mean value of F_{ST} calculated on the base of the esterase isozymes polymorphism, showed that 31.16% of the genetic variability was observed between the different strains, which corresponds to the level of the inter-strain genetic differentiation. The phylogenetic tree constructed by the UPGMA method consisted of two major subgroups from E 29 strain. These data for the inter- and intra-strain diversity and strain differentiation could be used for breeding purposes of the mulberry silkworm *Bombyx mori* L. and marker-assisted selection.

Keywords: *Bombyx mori* L., nonspecific esterases, phylogeny

Introduction

The mulberry silkworm, *Bombyx mori* L., has long been used as a model system for basic studies. The economic and scientific significance of the silkworm has made this species the subject of intensive genetic studies since the beginning of the last century, and thus, the most important insect genetic model after *Drosophila melanogaster*. The mulberry silkworm has a large number of geographical strains and inbred lines which show substantial variation for a large number of quantitative traits. More than 400 mutations affecting many fundamental aspects of the insect life cycle, including egg and egg shell formation, early embryonic pattern formation, development and diapause, larval feeding behavior, and molting have been identified (Nagaraju and

Goldsmith, 2002). The traditional breeding activities, involving hybridization between members of elite groups, are adding new breeds every year. At present, in the silkworm, traits such as cocoon shape, cocoon colour, silk fibre length, larval duration, together with many other ethological traits, are used to differentiate varieties. The selection of parental strains for a breeding programme is based on these characteristics. But the silkworm varieties, particularly those which have been bred from crosses involving many varieties, cannot be distinguished unambiguously by the use of conventional characteristics. It is thus apparent that the use of molecular markers could provide a solution to the problem, by providing specific DNA and isozyme profiles (Reddy et al., 1999). Development of molecular markers is important in silkworm for breeding purposes and marker-assisted selection (Prasad et al., 2005). The isozyme profiles of the strains would be useful in producing reliable estimates of genetic diversity, for the selection of parents for the development of elite hybrids

The present study was carried out to determine the degree of diversity and the existing relationships among ten silkworm strains with different origin belonging to the silkworm germplasm bank of Bulgaria, using isoenzyme markers.

Materials and methods

Ten strains of mulberry silkworm with different origin were tested: Vratza 1, Gergana 1, Gergana 2, Ogosta 1, Belopol 1/18 and Belopol 2/21 – from Bulgaria; Alb Cislau 29 – introduced from Romania; Syria 1 – from Syria; Ukrainian 20 - from Ukraine; E 29 – from Egypt. All individuals were nourished under a standard regime of silkworm breeding in Sericultural Experiment Station (SES) – Vratza and Agricultural University – Plovdiv. From 30 to 40 larvae were selected randomly from each strain on the fifth day of the fifth instar and were used in the study. The larval haemolymph was taken with a transactional cut through one of the prolegs. To avoid the activity of prophenol oxidase followed by melanization of haemolymph, a small amount phenylthiourea was added to the samples as well as 0.8M tris-phosphate buffer at pH 6.7. The spectrum of non-specific esterases (EST) (EC 3.1.1) from hemolymph was studied by means of 7.5% PAGE (Stoykova et al., 2003). 10μl of each sample was applied into the gel. Method of Shaw and Prasad (1970) was used to visualize the non-specific esterases.

Allele and genotype frequencies, observed (H_o) and expected (H_e) heterozygosity, deviation from the Hardy-Weinberg equilibrium, Nei's genetic distance (D) (Nei, 1972), and Wright's fixation index, F_{ST} (Wright, 1965) were calculated using BIOSYS-1 (Swofford and Selander, 1981). The UPGMA dendrogram was constructed using the PHYLIP software package (Felsenstein, 1993).

Results and discussion

The non-specific esterases from the *B. mori* haemolymph were under polygene control and for four of the esterase genes (Bes A, Bes B, Bes D and Bes E) was described polymorphism (Egorova et al., 1985; He, 1995; Stoykova et al., 2003; Staykova, 2008), which was also confirmed in this study. Genepool of the studied ten races regarding their allele composition and the frequencies of different alleles was analyzed on the basis of this polymorphism. Race specificity was ascertained (Table 1).

He (1995) described polymorphism with a "deletion" type esterase - BesAo in some races and hybrids bred in China. In this study we found polymorphism on the Bes A locus in the races Alb Cislau 29 and E 29. In the genepool of Alb Cislau 29 we established Bes A_0 and A_1 alleles, while in the genepool of E 29 we found Bes A_1 and

A_2 alleles. The Bes A locus was monomorphic in all other tested strains and present with Bes A_1 allele.

For strains Belopol 1/18, Belopol 2/21, Gergana 1, Gergana 2 and Alb Cislau 29, the Bes B locus was present with three alleles - Bes B_1, B_2 and B_3. In the Vratza 1 and Syria 1 strains genepool we found alleles Bes B_1 and B_3, and for Ogosta 1 and E 29 - Bes B_2 and B_3. In the genepool of Ukrainian 20 the Bes B_1 allele was fixed. The Bes B_1 frequency was the highest for the Gergana 1 strain, the Bes B_2 allele – for Ogosta 1, and the Bes B_3 – for Syria 1.

We found a three-allele polymorphism of locus Bes D (Bes D_1, D_2 and D_3) for strains Vratza 1, Belopol 1/18, Belopol 2/21 and Gergana 2. For Ogosta 1 and Ukrainian 20 we found a two-allele polymorphism with the presence of Bes D_1 and D_2 alleles; the same for Gergana 1, Alb Cislau 29 and Syria 1 – with the presence of the Bes D_1 and D_3 alleles, and for E 29 – with the presence of the Bes D_1 and D_0 alleles. We established the highest frequency of the Bes D_1 allele for the strain Gergana 2, of Bes D_2 – for Belopol 2/21, and of Bes D_3 – for Syria 1. The Bes D_0 allele was present in the genepool of the strain E 29, only.

The Bes E locus was polymorphic and represented by three alleles (Bes E_0, E_1 and E_2) in the genepool of strains Vratza 1, Belopol 1/18, Belopol 2/21 and Syria 1, two alleles (Bes E_0 and E_1) in the genepool of strain Alb Cislau 29, two alleles (Bes E_0 and E_2) in the genepool of Gergana 1, Gergana 2 and E 29. For Ukrainian 20, the Bes E_0 allele was fixed, while for Ogosta 1 – the Bes E_1 allele. Among all strains where we found polymorphism of locus Bes E the highest frequency was demonstrated by the Bes E_0 allele.

The average number of alleles per locus calculated with BIOSYS-1 (Table 2) varied from 1.3 (for Ukrainian 20) to 2.5 (for Belopol 1/18 and Belopol 2/21). The degree of polymorphism (according to the criterion 0.95) was the highest for strains Alb Cislau 29 and E 29 (100%), and the lowest – for Ukrainian 20 (25%).

The observed heterozygosity (H_o) calculated with BIOSYS-1 (Table 2) varied from 0.392 (for Alb Cislau 29) to 0.083 (for Ukrainian 20). The expected heterozygosity (H_e) was higher than the observed one in all tested strains with demonstrated polymorphism. The test for conformance to Hardy-Weinberg equilibrium manifested significant differences between the obtained and expected genotype frequencies of the most esterase loci for the most of the strains (except for Alb Cislau 29) resulting from the selection.

The mean value of F_{ST} (0.3116) calculated on the base of the established polymorphism, showed that 31.16% of the genetic variability was observed between the different strains, which corresponds to the level of the inter-strain genetic differentiation. On the grounds of the allele frequencies a genetic distance by Nei (1972), which varied from 0.050 (between the strains Belopol1/18 and Belopol 2/21) to 0.768 (between strains Ogosta 1 and Ukrainian 20) was also calculated (Table 3). Our results from isozyme divergence of the non-specific esterases and phylogenetic analysis suggested that the relative relationships between the E 29 and the strains Syria 1, Alb Cislau 29, Gergana 1, Gergana 2, Ukrainian 20, Belopol 1/18, Belopol 2/21 and Vratza 1 are closer than that between these strains and the Ogosta 1. The phylogenetic tree constructed by the UPGMA method consisted of two major subgroups from E 29 strain. The first one contained strains Syria 1, Alb Cislau 29, Gergana 1 and Gergana 2, and the second one included Ukrainian 20, Belopol 1/18, Belopol 2/21 and Vratza 1 (Fig.1).

The data obtained in this study for the inter- and intra-strain diversity and strain differentiation could be used for breeding purposes of the mulberry silkworm *B. mori* L. and marker-assisted selection.

Acknowledgments

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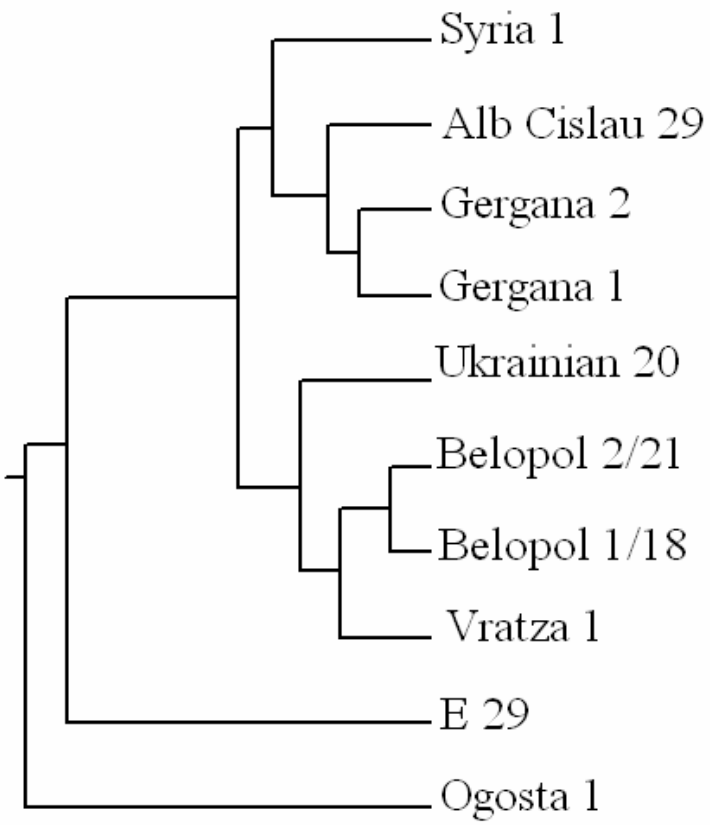

Fig.1. UPGMA-derived dendrogram illustrating the relationships among ten silkworm strains as inferred by isozyme analysis.

Table 1. Allele frequencies in strains tested

Strains	Locus												
	Bes A			Bes B			Bes D				Bes E		
	A_0	A_1	A_2	B_1	B_2	B_3	D_0	D_1	D_2	D_3	E_0	E_1	E_2
Vratza 1	0	1	0	0.567	0	0.433	0	0.350	0.350	0.300	0.467	0.350	0.183
Belopol 1/18	0	1	0	0.600	0.325	0.075	0	0.138	0.500	0.363	0.775	0.112	0.112
Belopol 2/21	0	1	0	0.256	0.423	0.321	0	0.115	0.654	0.231	0.692	0.167	0.141
Gergana 1	0	1	0	0.691	0.147	0.162	0	0.824	0	0.176	0.662	0	0.338
Gergana 2	0	1	0	0.200	0.200	0.600	0	0.833	0.100	0.067	0.600	0	0.400
Ogosta 1	0	1	0	0	0.528	0.472	0	0.556	0.444	0	0	1	0
Alb Cislau 29	0.300	0.700	0	0.517	0.050	0.433	0	0.667	0	0.333	0.750	0.250	0
E 29	0	0.500	0.500	0	0.317	0.683	0.533	0.467	0	0	0.633	0	0.367
Ukrainian 20	0	1	0	1	0	0	0	0.551	0.449	0	1	0	0
Syria 1	0	1	0	0.053	0	0.947	0	0.487	0	0.513	0.566	0.303	0.132

Table 2. Mean number of alleles per locus, proportion of polymorphic loci, observed (H_o) and expected heterozygosity (H_e)

Strains	Mean sample size per locus	Mean no. of alleles per locus	Percent Polymorphic loci (P=0.95)	H_o	H_e
Vratza 1	30.0±0.0	2.3±0.50	75.0	0.283±0.097	0.453±0.156
Belopol 1/18	40.0±0.0	2.5 ±0.50	75.0	0.262±0.107	0.380±0.135
Belopol 2/21	39.0±0.0	2.5±0.50	75.0	0.192±0.107	0.413±0.143
Gergana 1	34.0±0.0	2.0±0.40	75.0	0.096±0.058	0.308±0.111
Gergana 2	30.0±0.0	2.3±0.50	75.0	0.142±0.067	0.338±0.127
Ogosta 1	36.0±0.0	1.5±0.30	50.0	0.153± 0.089	0.252±0.145
Alb Cislau 29	30.0±0.0	2.3 ±0.30	100	0.392±0.044	0.453±0.036

E 29	30.0±0.0	2.0±0.00	100	0.275±0.086	0.482±0.016
Ukrainian 20	39.0±0.0	1.3±0.30	25.0	0.083±0.083	0.125±0.125
Syria 1	38.0±0.0	2.0±0.40	75.0	0.125±0.054	0.296±0.144

Table 3. Nei's (1972) genetic distance (above diagonal) based on isoenzymes

	Vratza 1	Belopol 1/18	Belopol 2/21	Gergana 1	Gergana 2	Ogosta 1	Alb Cislau 29	E 29	Ukrainian 20	Syria 1
Vratza 1	*****	0.102	0.121	0.134	0.160	0.305	0.128	0.491	0.157	0.149
Belopol 1/18		*****	0.050	0.180	0.292	0.527	0.224	0.606	0.101	0.366
Belopol 2/21			*****	0.285	0.240	0.342	0.294	0.469	0.223	0.282
Gergana 1				*****	0.089	0.586	0.105	0.424	0.108	0.291
Gergana 2					*****	0.402	0.147	0.227	0.283	0.131
Ogosta 1						*****	0.510	0.700	0.768	0.367
Alb Cislau 29							*****	0.400	0.178	0.161
E 29								*****	0.670	0.315
Ukrainian 20									*****	0.512
Syria 1										*****

THE EFFECT OF METHOPRENE TREATMENT ON VTH INSTAR SILKWORM LARVAE REARED ON ARTIFICIAL DIET

By

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(ORAL PRESENTATION)

Silkworm rearing on artificial diet shows many advantages if compared to leaf sericulture, especially with regard to the new field of protein production for bio-medical aims. Nevertheless, silk harvesting by artificially reared larvae appears to be slightly lower than that obtained with mulberry leaf.
In order to overcome this problem, apart for amelioration of artificial diet, the practical application of synthetic juvenile hormone-like substances might be explored. The technique was already applied in the past for leaf rearing, resulting in prolongation of mulberry eating period, increasing in single cocoon weight and amelioration of silk thread length.
This paper deals with some preliminary results obtained by Methoprene (Manta) topical treatment of polyhybrid larvae reared on the artificial diet produced and patented by CRA-API.
Application of different doses of the active ingredient in different days of the initial stage of the fifth instar, gave rise to various biological behaviours of treated larvae.
Keywords: artificial diet, polyhybrid larvae, methoprene, juvenile hormone

Introduction

Insects undergo various changes in morphology during their life-cycle which are described as metamorphosis. Three types of hormones, brain hormone (produced by neurosecretory cells in the brain), ecdysone (produced by prothoracic glands) and juvenile hormone (JH) (secreted by corpora allata) regulate the insect development from egg to adult. In particular, the role of JH is to inhibit metamorphosis and to maintain larval characters.
Synthesis of compounds which are structurally similar to the natural JHs has been carried on massively in the past and they have been tested on *Bombyx mori* as insect growth regulators, especially with the aim of increasing cocoon weight and raising the quality of cocoons, which in turn, resulted in improving economic effectiveness of sericulture (Akai et al., 1984, 1985; Kajiura et al., 1987; Kajiura & Yamashita, 1989; Chowdhary et al., 1990; Leonardi et al., 1996). These chemicals generally act by maintaining the larval characters for a prolonged time and consequently by extending the feeding period, resulting in this way to an increase in the silkworm body weight and an improvement of the single cocoon's weight.
Juvenile hormone analogues (JHA) have been extensively used to treat silkworms reared on leaves, while studies about their administration to larvae reared on artificial diet are lacking.
However, this case might be of great practical importance, in connection to the fact that silkworm larvae have been used as a bioreactor for recombinant protein production for decades. The first report on the production of human interferon alpha (IFN-α) in the hemolymph of silkworm larvae using BmNPV, containing the gene encoding human α-

interferon driven by the polyhedrin promoter, was by Maeda et al. (1985). From that moment, several foreign proteins have been expressed in silkworm larvae. Transgenic larvae production is a delicate and expensive process, therefore losses of harvest due to diseases should be completely eliminated. Such larvae are produced usually on a continuous rearing cycle, apt to the industrial uses. For this reason, artificial diet rearing is usually coupled with transgenic larvae production. Nevertheless, production performances of larvae reared on artificial diet are slightly reduced in comparison to those of leaf-reared larvae. This is why through this work was tried an investigation of the feasibility of Manta treatment on Suggested by diet-reared larvae.

Materials and Methods

Polyhybrid larvae produced by CRA-API (Padua-Italy) were reared under 12:12 D/L photoperiod, decreasing temperature from 29°C to 25°C, according to the progression of the larval instars from the first to the fifth and decreasing relative humidity, until reaching 70±5% in the last instar.
Silkworms were reared with artificial diet (CRA-API Patent, Cappellozza et al., 2005), containing decreasing quantity of mulberry leaf (from 25% in the first instar to 5% in the last). Larvae were topically treated with a solution of Manta diluted in ethanol. Pestanal (methoprene, analitycal standard) was purchased by Sigma-Aldrich.
Accordingly to the concentration (2.5 ppm) suggested by the production company (Zoecon Corporation, Palo Alto, California), different concentrations were tested. Furthermore, even though the treatment was suggested by Zoecon from the 48^{th} to the 60^{th} hr of the last instar, in our experiments it ranged in a period from the 0 (immediately after moulting) to the 72^{nd} hr. However, some preliminary tests were performed in order to evaluate which were the doses causing no increase in mortality even though administered in a later stage.
Groups of larvae were made by at least 10 larvae per each sex.
ANOVA analysis was carried out and the significance of the interactions: Time of Treatment x Doses x Sex and Time of Treatment x Doses were evaluated. Tukey's test was performed in order to judge differences among means.

Results

Production data of the first experimental set are presented in Table 1. For the two tested doses, the improvement of silk production over the control increased with time elapsing, reaching its maximum around the 48^{th} hours, with some differences according to the sex, and with a marked effect related to the day more than to the doubling of the treatment doses.
The limited increase in silk production for the treatment at hour 0 as well as the scarce delay in spinning time is probably related to quick metabolism of the chemical.
No increase in mortality was recorded in treated lots, even though some non-transformed larvae (larval-pupa intermediates) were found into the cocoons of 24 and 48 hr treated groups.
In general the increase of the cocoon weight was higher than the increase in the silk shell, but even this physiological behaviour was related to the time of treatment and the hormone doses.

Table 1: First experimental set: two doses (156 and 313 ng) topically administered at hour 0, 24, 48 of the last instar

Treatment	Sex	Cocoon weight (g)	Shell weight (g)	Silk percentage (%)	Delay in spinning in comparison to control (hrs)
Control (Et-OH)	M	1.227 ± 0.081	0.239 ± 0.019	19.5 ± 1.8	-
	F	1.541 ± 0.095	0.267 ± 0.016	17.3 ± 4.0	-
Hour 0 – 156 ng/larva	M	1.416 ± 0.108 15%	0.259 ± 0.027 8%	18.3 ± 1.3	12
	F	1.787 ± 0.228 16%	0.298 ± 0.040 12%	16.7 ± 1.1	12
Hour 0 – 313 ng/larva	M	1.419 ± 0.096 16%	0.279 ± 0.016 8%	19.7 ± 4.0	12
	F	1.867 ± 0.180 21%	0.306 ± 0.027 15%	16.5 ± 1.5	12
Hour 24 – 156 ng/larva	M	1.597 ± 0.171 30%	0.290 ± 0.039 21%	18.2 ± 19.0	48
	F	2.135 ± 0.235 39%	0.330 ± 0.031 24%	15.6 ± 2.3	48
Hour 24 – 313 ng/larva	M	1.646 ± 0.163 34%	0.279 ± 0.049 17%	17.1 ± 2.8	48
	F	1.866 ± 0.220 21%	0.283 ± 0.033 6%	15.2 ± 2.3	48
Hour 48 – 156 ng/larva	M	1.713 ± 0.110 40%	0.323 ± 0.038 35%	18.8 ± 1.8	48
	F	2.119 ± 0.216 37.5%	0.341 ± 0.056 28%	16.1 ± 2.1	48
Hour 48 – 313 ng/larva	M	1.682 ± 0.164 37%	0.314 ± 0.065 31%	18.5 ± 2.4	48
	F	2.029 ± 0.284 31%	0.332 ± 0.048 24%	16.3 ± 4.0	48

Red percentages are increases over the control values.

Table 2: Second experimental set: decreasing treatment doses (469 – 313 -156 – 78 ng) with time elapsing in the fifth instar (0 – 24 –48 –72 hr)

Treatment	Sex	Cocoon weight (g)	Shell weight (g)	Silk percentage (%)	Delay in spinning in comparison to control (hrs)
Control (Et-OH)	M	1.284 ± 0.214	0.221 ± 0.036	17.3 ± 1.2	-
	F	1.632 ± 0.091	0.281 ± 0.020	17.2 ± 0.1	-
Hour 0 – 469 ng/larva	M	1.850 ± 0.129 44%	0.302 ± 0.034 37%	16.6 ± 2.0	48
	F	2.144 ± 0.418 31%	0.315 ± 0.046 12%	14.9 ± 1.8	48
Hour 24 – 313 ng/larva	M	1.769 ± 0.290 38%	0.296 ± 0.042 33%	16.9 ± 1.8	48
	F	1.973 ± 0.302 21%	0.306 ± 0.041 9%	15.4 ± 1.2	48
Hour 48 – 156 ng/larva	M	1.792 ± 0.227 40%	0.299± 0.038 35%	16.8 ± 2.3	48
	F	2.208 ± 0.327 35%	0.347 ± 0.054 23%	15.7 ± 1.3	48
Hour 72 – 78 ng/larva	M	1.320 ± 0.229 3%	0.253 ± 0.059 14%	18.4 ± 4.2	6
	F	1.992 ± 0.237 22%	0.305 ± 0.054 9%	15.4 ± 2.9	48

Red percentages are increases over the control values.

The interaction Time of treatment x Doses x Sex was not significant, neither for the cocoon weight or for the cocoon shell, while it was for the Time of treatment x Doses.
Table 3 shows the value for the second experiment, where we cumulated data obtained for male and female cocoons together.

Table 3: Second experimental set: decreasing treatment doses (469 – 313 -156 – 78 ng) with time elapsing in the fifth instar (0 – 24 –48 –72 hr). Male and female data were analysed together.

Treatment	Cocoon weight (g)	Shell weight (g)	Silk percentage (%)
Control (Et-OH)	1.522 e	0.265 dc	17.4 b
Hour 0 – 469 ng/larva	1.976 a	0.307 ab	15.5 b
Hour 24 – 313 ng/larva	1.834 ab	0.300 ab	16.4 b
Hour 48 – 156 ng/larva	1.972 a	0.281abcd	14.2 b
Hour 72 – 78 ng/larva	1.645 edcb	0.278 dc	16.9 b

Value followed by different letters significantly differ at $P<0.01$

In general results show that higher doses are necessary in order to obtain similar effects with time elapsing in the fifth instar. In addition, the lack of significance of the interaction of superior rank put in evidence that the number of analysed worms probably should be more than 10 per group. This could be in turn due to the fact that individual fluctuations affected the experiments in a relevant manner and that standard deviations resulted quite high.

Discussion

The described experiments demonstrated that it is possible to apply Manta treatment, with good results, even in the case of diet rearing. The increase of the silk production is generally remarkable, even though probably the doses should be studied more in depth in order to find a good balance between the increase in the shell weight and in the pupal weight. Our results are quite different from those of Miranda et al. (2002), where the quantity of Manta was rather low in comparison with ours. This could also depend on the purity of the product we used.

Fast degradation of the chemical due to the insect metabolism was proven by the fact, that very high doses at the beginning of the last instar were not harmful to the larvae and they did not cause very big delay in spinning. Treating larvae at the beginning of the last instar is very convenient from a practical point of view, as they have to be transferred to the new diet after the last moult, so that it is necessary to handle them, and that is the perfect time to topically treat them, in order to not repeat the operation more than once.
Furthermore, in case of rearing under germfree conditions (Sumida et al., 2007), larvae should be left eating in the dark until the end of the fifth instar, so that treating them at the beginning of the instar appears to be very opportune. In addition, we noticed that there was a direct relationship between the doses, the moment of treatment and the incapability of some larvae to transform into adults, even though they spun their cocoons. Therefore, anticipating the treatment is safer, as larvae have longer time in order to metabolize the chemical into their bodies.
To sum up, we think that Manta treatment of diet-reared larvae could be convenient especially in case of production of particular importance (recombinant proteins) where the high added value of the final harvest justify the cost of the chemical and of the treatment.
In this specific case ethanol treatment was implemented, but even water spraying on just-moulted larvae could be studied in order to avoid individual treatments.

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SEQUENCE ANALYSIS AND EXPRESSION OF THE CHITINASE GENE (*M-CHITINASE*) IN MULBERRY (*MORUS* L.)

By

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(POSTER)

EST encoding Chitinase was isolated from the mulberry c DNA library previously constructed by SMART method. And it's full open reading frame were obtained by RACE and RT-PCR for the first time in mulberry. A full length cDNA sequence coding for Chitinase in mulberry was designated *M-chitinase* (GenBank accession number: HQ117891). Sequence analysis showed that the *M-chitinase* is 1392 bp long and contains a 60 bp 5'-UTR (untranslated region) and a 255 bp 3'-UTR. It's opening frame (ORF) is of 1077 bp, encoding 358 amino acids with a predicted molecular weight of 38.52KD and an isoelectric point of 4.466. Homology analysis revealed that *M-chitinase* gene are highly conservative in mulberry and other species including *N. khasiana, Zea mays* and *Zea Diploperennis*. Phylogenetic analysis based on *M-chitinase* gene with other 19 species showed that mulberry shows closer relationship with *Nicotiana gossei*, *nicotiana tabacum*, *Capsicum annuum* and rock cress. The results of semi quantitative RT-PCR analysis showed that the transcriptional level of *M-chitinase* mRNA in the young leaf are most abundantly expressed. And the transcriptional level of *M-chitinase* mRNA changed significantly under the conditions of cold, SA and ABA stresses respectively compared to the normal growth environment.
Keywords: Mulberry; *M-chitinase*□Gene cloning□Sequence analysis; Gene expression

NATIONAL BIO-RESOURCE PROJECT IN JAPAN AND DEVELOPMENT OF CRYOPRESERVATION METHODS FOR SILKWORM RESOURCES

By

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(ORAL PRESENTATION)

Abstract: National Bioresource Project (NBRP) of Japan started in 2002 by the support of Ministry of Education, Culture, Science, Sports and Technology. Silkworm is not only important insect for sericulture but also a good model organism suitable for research of life science. The purpose of this project is to collect, preserve, and provide bio-resources that are basic materials for life sciences research so that studies using the silkworm are promoted. To this aim, Kyushu University has been adopted as core facility (sub facility: University of Tokyo, Shinshu University and NIAS). Most of the efforts would be paid for collection, preservation and distribution of resources. Now, there are approx. 850 silkworm strains that can be broken down into 450 mutant strains, 200 improved strains that can feed on an artificial diet without problems and 100 transgenic strains and others. Moreover, our project also has constructed DNA repository that stock the DNA of the silkworm and wild silkworm, *B. mandarina*. From Shinshu University about 70 strains of wild silkworm are available for researchers. University of Tokyo maintains genome resources, i.e. approx. 50 genomic-DNA/cDNA libraries of *B. mori*, *B. mandarina,* and *Samia cynthis ricini*. The resources are currently widely available to users and have become available all year round through NBRP. To get the resources from NBRP, the maternal transfer agreement (MTA) issued by NBRP is used.

With the progress of this project, the number of stocked resources increases, and then safety and effective system for preservation of resources is needed. We are making an effort to develop the cryopreservation methods of silkworm resources. The tolerance of survival to the cryopreservation was evaluated by using sperm, ovaries and testis. It was very different among strains in sperm. The difference among strains was small in ovary. The survival ratio in testes was lower than sperm and testes. In order to get next generation from cryopreservation ovaries, transplantation into previously castrated female is needed. About 30 % female moths transplanted are laying eggs. More improvement is necessary for using this system as general manual.

Keywords: Silkworm, cryopreservation, genetic resources, NBRP

□□Activities of NBRP

1. Outline

The purpose of NBRP is to construct the framework for systematic collection, preservation, and distribution of bioresources. The project focuses on 27 bioresources (Table 1). Silkworm has been adopted as one of them. Now project is in phase 2(2007-2011). The goals of this project are to build up bioresources of the highest level in the world by 2010. In phase 2, silkworm project is implemented by Kyushu University (core facility), University of Tokyo, Shinshu University, and the National Institute of Agrobiological Sciences. The information of this project is available on web at http://www.nbrp.jp handled by the core facility, National institute of Genetics. For silkworm users, “Silkwormbase” has prepared and published as database in cooperation with Dr. Yamazaki, Genetics Research Institute, NBRP Information Center.

Table 1 List of bioresources selected for NBRP

Resources			
animals	Mice	plants	Arabidopsis
	Rats		Rice
	Drosophila		Wheat

	C. elegance		Barely
	Xenopus		Algae
	Silkworm		Chrysanthemum
	Medaka		Morning glory
	Zebrafish		Lotus/Glycine
	Japanese macaques		Tomatoes
	Ciona intestinalis /Oxycomanthus japonicas		
Micro-organisms	Cellular slime molds	Cells, etc.	DNA material
	Pathogenic microorganisms		Stem cells
	General microbes		Cells
	E. coli, B. subtilis		
	Yeast		

2. Roles of organizations participating

Kyushu University: Collection, maintenance and supply of silkworm strains

1) Creation of world-class collection of mutant strains, upgrading of collection of strains adapted to artificial diet, and improvement in quality of strains maintained.

2) Establishment of a method of safe and efficient maintenance of resources through cryopreservation of germplasm and practical application of artificial insemination technology.

3) Establishment of a system to supply silkworm strains year round.

Kyushu University has standard strains and various mutant strains of silkworms, as well as *B. mandarina,* which is considered to be a silkworm of the ancestral type. Our stocked numbers reached at approx. 850 silkworm strains. Those bioresouces can be broken down into 450 mutant strains, 200 improved strains that can feed on an artificial diet and 100 transgenic strains and others. The p50 strain, performed genome analysis, is the most popular strain in our stocks among researchers. Because p50 has standard phenotype of silkworm and high resistance to disease, it is easy to handle as experimental animal for researchers. Each strains collected by this project is effective for the elucidation of various processes in life stage.

NBRP handles year-round supply of silkworm eggs. As a system to supply the resources year-round, NBRP promotes a project to prepare two kinds of eggs which are for the acid-treatment after chilling and for the artificial hibernation.

University of Tokyo: Collection, maintenance and supply of genome resources

1) Upgrading and efficient maintenance of cDNA clones and BAC library and improving accessibility. University of Tokyo possesses approx. 50 genomic-DNA/cDNA libraries of *B. mori*, *B. mandarina,* and *Samia cynthis ricini*. In particular, it stores and supplies more than 200,000 cDNA clones, derived from various developmental stages and tissues in *B. mori* and *S. c. ricini.* Detailed information is published in http://morus.ab.a.u-tokyo.ac.jp.

Shinshu University: Collection, maintenance and supply of wild silkworm strains.

1) Collection, maintenance and supply of wild silkworm resources, such as *Antheraea yamami, Antheraea pernyi, Samia cynthia pryeri*. Shinshu University has collected 70 wild silkworm strains, and also stocked DNA specimens.

National Institute of Agrobiological Sciences (NIAS) : Collection and evaluation of genetically modified silkworm.

1) NIAS handles to collect and evaluate the transgenic silkworms, the storage and supply of which is supported by Kyushu University. There are 100 strains available for distribution and

NIAS plans to add 20 new strains every year. Detailed information of available strains is published at http://sgp.dna.affrc.go.jp/ETDB/.

3. How to access to the NBRP

When you want to use silkworms stocked in the NBRP, please to access our homepage http://www.nbrp.jp/index.jsp. You will find out adequate information. Also, NBRP responds to direct inquiries at the following address:

6-10-1 Hakozaki, Higashi Ward, Fukuoka City, 812-8581
Yutaka Banno, NBRP "Silkworm", Faculty of Agriculture, Graduate School of Kyushu University
E-mail: banno@agr.kyushu-u.ac.jp
Tel□Fax: 092-624-1011
Tel: 092-621-4991

□□Development of cryopreservation methods for silkworm resources.

Recently some studies were reported for long-term preservation of silkworm. Takemura *et al*. had reported artificial insemination using cryopreserved sperm (1999, 2000). Moreover, Mochida *et al*. had shown that fertilized eggs could obtain from transplantation of frozen ovaries (2003). These reports are very hopeful for safety and efficiency preservation of many genetic resources of silkworm and related insects. However, mostly experiments had been done using hybrid races, and the success ratio is not sufficient for practice use.

About three years, we evaluated the availability of the reported methods by using many strains (supported by NBRP).

1. Artificial insemination using cryopreserved sperm.

The methods can divide into three steps. 1) Collection of the silkworm sperm from male seminal vesicle of moths. 2) Freezing process (cryopreservation) of the sperm. 3) Insemination. Long time and skillful technique are needed in first step. 65-80μℓ sperm is minimum volume for insemination, because smaller volume than this makes lower success ratio. 65-80 μℓ sperm can use artificial insemination for 10 female moths. When we collect this volume of sperm from commercial races, we need 3 hours under the skillful person. In this process, to avoid the contamination that is caused by other tissues such as fat body and some tiny granules is essential. We can handle the tasks within short time at second and third step. Our experiment showed that the success ratio was very different between strains. In the test using commercial strains or hybrid strains, the ratio was high (50-80%). On the other hand, the pure or regional strains indicated very low ratio. There were no fertilized eggs in many strains.

2. Usage of frozen ovary and testis.

Experiment methods are not so complex compared with artificial insemination using sperm. Ovaries frozen in liquid nitrogen should be taken out from donor silkworm at third or fourth instar. Thawed ovaries were transplanted into ovary ectomized female larvae of third or fourth instar. 1.5M DMSO (Dimethyl sulphoxide) or Cell banker-2 was used as cryoproptectant. We modified the original cooling step developed by mochida (2003). The cooling ratio at 1 degree Celsius /1 minute for 2hours made up higher survival ratio than before methods. The ratio was 20-80% in the case of hybrid strains. In the case of pure or regional strains, the ratio was in 0-30%. We have checked whether this method was available for testis. We need repetitive test, however in two strains 10% survival were recognized in preliminary experiments.

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PREPARATION OF SEVERAL TYPES OF RECOMBINANT SERICIN-LIKE PROTEINS

By

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(POSTER)

The spun-out silk fiber consists of two fibroin filaments that are cemented together by sericin coating. The serine-rich sericins, which make 20-30% of the cocoon silk proteins in *Bombyx mori*, are dissolved in hot water during silk fiber reeling from the cocoon. The sericin extract is usually discarded. Only small amounts are currently used in cosmetics and lately also as replacement of bovine serum products in the cell culture media. The use in culture media is hindered by poor standardization of the extracts. To overcome this problem, we attempted preparation of several recombinant proteins based on partial sequences of two out of the three sericin genes of *Bombyx mori*. The *Ser2* gene encodes a shorter and a longer version of a protein which is composed of diverse, mostly charged amino acid residues. Unusual for the silk proteins is the high contents of lysine and proline and only moderate content of serine. By contrast, the deduced translation product of the *Ser3* gene is extremely serine-rich with a relatively high representation of the aspartate, asparagin, glutamate, and glutamine. Using specific primers we have prepared a cDNAs of 362 bp derived from *Ser2*, and cDNAs of 406, 655, 706, 448, and 775 bp, respectively, derived from the *Ser3* gene. The cDNAs were cloned and expressed as fusion proteins with hexahistidine in *Escherichia coli.* The proteins were purified by affinity chromatography and analyzed by acrylamide electrophoresis. The Ser2-1 protein includes 6 repeats of a degenerate motif rich in glutamate; this repetitive region is flanked by non-repetitive sequences of 20-30 amino acid residues, respectively. Proteins derived from the Ser3 gene contain repetitive motifs rich in serine and including some charged amino acids.
Keywords: silkworm, recombinant sericin, expression of repetitive motifs, *Ser2* gene, *Ser3* gene

SERICIN COATING OF CULTURE DISHES PROMOTES CELL GROWTH

By

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(POSTER)

Cell adhesion is involved in a variety of processes, including survival, differentiation, migration, and proliferation that occur in embryogenesis, wound healing and tissue remodeling. Most cell types grown *in vitro* require attachment to a surface and the nature of this substrate has a major effect on the cell growth and the requirement for serum proteins in the culture medium. Tissue culture plastics (polystyrene) must be treated to become hydrophilic (and negatively charged). Over the years, many researchers have shown that various cell cultures can be improved dramatically by coating the surface of culture dishes with positively charged artificial polymers, i.e., poly-D-lysine, or with tethered adhesion molecules such as laminin and collagen. Insect silk offers a number of charged adhesive molecules that might include sequences similar to those occurring in the cell-anchoring proteins of extracellular matrix and, at the same time, resist action of the cell-derived proteases. The sericins of *Bombyx mori* are particularly promising because they are able to spread out and coat hydrophobic surfaces that repel other water solutions (including that of poly-D-lysine). We have tested coating of plastic dishes with a mixture of natural sericins and with recombinant proteins based on the sequence of sericin 2 and expressed in *Escherichia coli*. Truncated recombinant sericin variants A (deduced size 33.5 KDa), B (30.2 kDa), GL1 67.6 (kDA), and GL2 (30.2 kDa) differed in their ability to support proliferation of *Drosophila* Cl8+ cells, which grow strictly in an anchorage-dependent manner. In our experiments, the cells failed to grow and mostly died within 48 hrs in untreated polystyrene plastic dishes, but survived after coating the dish surface with sericin products (either natural or recombinant). The results indicate that a short charged motif is responsible for the support of cell adhesion and proliferation.
This study was in part supported by project P502/10/2382 of the Czech Science Foundation.
Keywords: cell adhesion, sericin coating, cell proliferation, cell death

EFFECTS OF SERICIN ON MAMMALIAN CELLS CULTURED IN VITRO

By

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(POSTER)

The sericins, which glue the pair of silk filaments into a single fiber and provide filament adherence for cocoon construction, are soluble in hot alkaline water. Sericin extract obtained from the cocoons of *Bombyx mori* and desiccated to a powder is sold as a component of cell culture media. Such a preparation purchased from Wako Co. (Japan) was tested in 0.001, 0.005 and 0.01 % concentrations on several types of cells cultured *in vitro*. Special attention was paid to the keratinocytes, which make up nearly 95% of cells present in human skin, and to the fibroblasts, which are essential components of the connective tissues. Both cell types play important roles in skin regeneration and plastic surgery. The standard cell line of human keratinocytes HaCaT grew well in the standard culture medium containing 10% fetal calf serum (FCS) and supplemented with commercial sericin to final concentrations 0.005 or 0.01%. The primary cultures of keratinocytes, which had been isolated from human skin, also proliferated well in special keratinocyte medium supplemented with 0.01% sericin. The human fibroblast cell line WS1 grew well in the presence of 0.01% sericin, and the primary cultures of human skin fibroblasts grew best at 0.001% sericin. Additional studies were done with the cultures of HeLa cells (human epithelial cells isolated from uterus cancer), Vero cells (derived from the kidney of *Cercopithecus aethiops* monkey), and the murine fibroblast cell line L929. Vero cells survived and assumed round shape in the medium lacking fetal calf serum (FCS) and containing 0.5 or 1% sericin. The two other types of cells required FCS. Addition of 0.5% sericin had no effect on the HeLa cells but caused rounding in some of the L929 cells. These preliminary data indicate that sericin cannot replace FCS in the cell culture media but seems to act as a growth stimulant when added to the standard media with FCS.
This study was in part supported by project P502/10/2382 of the Czech Science Foundation.
Keywords: sericin, fibroblasts, keratinocytes, mammalian cell lines

SECTION 4
ECONOMY: DOMESTIC AND INTERNATIONAL MARKETS, PRICES, TRADING, ECONOMIC ANALYSES OF PROJECTS ETC.

SILK FABRICS AND HEALTH

By

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The added value of silk was known from the time of its discovery. When the empress Xi Ling Shi had the silk thread in her hand, which her daughter had taken from the cocoon, it slipped her mind that she would make for her husband, the Emperor, an undershirt. This was 5000 years ago. Since then we have discovered that silk has the quality of a second skin.
Silk has special qualities that other fibers do not provide like breathing and the capacity to cleanse the body. It is very convenient to wear silk because of its healing qualities:

- Silk protects the skin against ultra violet sunrays
- It rejuvenates the skin because of its breathing capacity
- Silk cleanses the body by opening the pores and let perspiration escape
- It heals the body by activating the veins

Research was done in China and Japan on silk jersey as underwear and the positive effect on skin allergies, rashes and itchiness of the vagina during pregnancy.
The silk jersey is important for babies as the body temperature has to adjust to the world and silk helps to stabilize the effects of varying temperatures.
Sleeping between silk has many advantages like cleansing of the system because of the very deep sleep silk takes you in. By cleansing, it rejuvenates the body, calms the heart and exudes waste through perspiration.
Parkinson patients enjoy a better night rest as they can slip in and out of bed more easily.
I have testimonials from clients who suffer from diverse diseases and who benefit from our silk products. More study has to be done on the medical effects of silk and I would like to set up a network of scientists and silk producers to study the medical aspects of the use of silk.

SILK PRESENTATION PROCESSING ACTIVITIES IN PLACE PALOTAI, BIHOR, ROMANIA

By

Costache Rodica Georgeta

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(ORAL PRESENTATION)

The TORCITURA DI DOMASO was build up on 1966 with silkworking, and till today this is the core business of our society ! Mr Luigi Valsecchi, had token a closed twisting mill and brought it in one of the most important center for silk yarnthrown in Italy.
In seventy's/eighty's/ninety's the TORCITURA DI DOMASO was the laboratory of development in those years of the most modern till today used technologies for the silk processing.
The most important target of TORCITURA DI DOMASO, was and is still today the research of the best quality.

In the 1999, the Luigi Valsecchi's sons-Andrea and Mario- had decided to brought part of their Italian production in Romania (they were the first one to do this investment here!). During these years we reach the level to produce 20.000 kg/month thrown silk, covering all the articles tram, cresp, organzine aso
Even here in Romania, we look very attentively on the quality of our products, but also, on the raw materials, through an internal laboratory which is in straight co operation with the Textile Silk Center from Como- Italy.
The silk we are processing 20/22 den is on 90% of Chinese origin, where we have various co-operation with many reeling mill, and 10% is of Brazilian origin.
On the last few years the Chinese production has diminished of 30-40 % in quantity, but is a major preoccupation the qualitatively diminishment of the silk, and the Brazilian silk, being better on quality it is not sufficiently to cover the European consumption.
On the closing of my words, I would like to inform you on the quantities which Europe (mostly Italy) is importing from China:
Silk code 5002=1.000.000 kg/year
Silk code 5004= 600.000 kg/year
I think these are important numbers, that's why we wish that other countries should be interested in the development of silk worm and please be sure you'll find in us a good and interested partner !

ROLE OF SERICULTURE IN RURAL LIVELIHOOD FOR FARMERS OF MAHARASHTRA STATE; INDIA

By

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ABSTRACT

Maharashtra is a non-traditional State in Silk Production. However, Mulberry cultivation is practiced in Vidarbha, Marathwada and Western region and in the tribal districts like Bhandara, Chandrapur, Gadchiroli and Gondia Tasar cultivation is practiced for last 300 years. Maharashtra is growing up as a potential Mulberry raw silk producing State among the non-traditional states of India.Present production is 1744 mt of mulberry silk cocoons. The role of sericulture in rural livelihood is discussed in this paper.

INTRODUCTION:

Food, clothing and shelter are three basic needs of human. These needs are fulfilled by agriculture sector. The agriculture sector in India plays a dominant role in Indian economy although its share in total net domestic product has declined. Indian agriculture is highly susceptible to the vagaries of nature with substantial depending on the rainfall pattern.

Food grain production varies considerably between the successive years, frequently due to disruptive stock like floods, droughts and market trends. Prices of sensitive commodities severely affect economic conditions of farmers, labours and other rural people, representing more than 68.7 percent of total population. Government of India having appreciated the situation initiated steps by diversifying in livestock development, dairy, poultry, horticulture, sericulture, mixed farming etc., for ameliorating the conditions to great extent.

The farm sector has limitations in increasing the income of farm families mainly due to decreasing average farm size and net realization from the farm produce per family. Identifying off-farm employment opportunities to small, marginal farm and landless families at the post production phase may lead to more attractive and perhaps everlasting solutions to challenges of rural economy, like up-liftment of the rural poor above the substance level, and increasing the living standards of rural people.

In this contest sericulture activity plays a significant role in the rural economy since it has roots in the on-farm agriculture. Off-farm operations, up to developing high fashion fabric and further processing, carries immense potential for value addition at every stage thereby providing economic activities to skilled , semi-skilled , un skilled workers from rural semi-urban & urban areas.

MATERIALS AND METHODS;

The information with respect to sericulture activities was collected by visiting different pockets of sericulture from both mulberry and Tasar silk production areas. Data was analyzed for further analysis of the sericulture activities.

RESULTS AND DISCUSSION:

The global scenario: The global raw silk production was around 1,54,000 MTs in the year 2007-08. China is the major producer with 81.65 percent share, followed distantly by India with 13.14 percent – a scenario akin to that of cotton. As regards trade, China also dominates in exports of raw silk, silk yarn and silk fabrics with a global share of more than 90%. It is relevant to note that while, production of silk in many countries have declined sharply except in China, there appears to be certain stagnation in the growth of Indian Sericulture, production ranging between 15,000 to 18,000 MTs during the last 5-6 years.

Sericulture in India :

Silk is known as queen of Textile and has a great liking and demand in the different strata of the society. Demand of silk sari and garment is growing day by day irrespective of age factor. India has long tradition and experience in the production and utilization of silk of all four types . During the year 2008-09 India produced 18370 MTs of raw silk.(15610MTs Mulberry and 2760 MTs Vanya silk) The Indian silk is mainly drawn from four varieties of silk i.e. Mulberry, Tasar, Muga and Eri over the years. Sericulture has acquired reputation for its activity in the global scenario. While providing a safety net for the rural poor (main practitioners) it fetched Rs.3166 crore in export earning alone in 2007-2008. India presently , holds a 13% share in world raw silk production to rank second after China. This generates rural employment for 6 Million people in its production chain in silk sector. Currently, the Silk demand in India is 26,000 MTs and in it Maharashtra’s share is

very negligible (200 MTs) however, there is great potential to develop silk sector in the state in view of its climate, manpower and soil conditions of this state's area.

Moriculture is an important agro-industry in the context of rural development and augmenting rural income and prosperity in view of its high employment potential, high profitability, comparatively low investment and remarkably short gestation period for producing practical economic results.

2. Present status of silk industry in Maharashtra

The higher altitudes, moderate temperature and good soil conditions in the State offer good scope for Sericulture development specially Mulberry and Tasar sericulture. Maharashtra State has also scope for promotion of eri i.e. castor silk. The farmers of Maharashtra have shown that they can produce superior grade cocoons than that of the farmers producing in neighboring traditional State.

The net irrigated area is 33,500 square kilometers. 57.07% of the land is under food grain crops. Hence there is good scope to expand mulberry cultivation and for promotion of silk sector in Maharashtra State.

Mulberry sericulture is practiced in 1125 villages of 22 districts of Vidarbha, Marathwada and West Maharashtra, by about 8000 families, having about 10450 acres Mulberry plantation. The main districts are Pune, Satara, Sangli, Solapur, Kolhapur, Ahmednagar, Washim, Buldana, Nagpur, Aurangabad, Hingoli and Beed .There is an effective area of about 6000 acres under mulberry plantation in the state. Maharashtra is third largest state in terms of area and one of the industrially and agriculturally advanced States in the country. The rural population however depends mainly on agriculture activity and over 64% of the people are employed in agriculture and allied activities. Maharashtra is a non-traditional Mulberry silk producing state in the country occupying second position among non-traditional States and seventh position among all the Mulberry silk producing States in the country in respect of Mulberry raw silk production. Maharashtra presently produce 1744 MTS of cocoons and 200 MTs of mulberry and 8 MTs of tasar raw silk, this generate rural employment for 60000 people in production chain in silk sector.

Maharashtra is developing as a potential Mulberry raw silk producing State among the non-traditional states. Under the reeling sector, 5 Filatures, 14 Charakas, 110 Cottage Basins and 140 Multi-end units are functional. There are only 360 twisting spindles in the State. Apart from above, 196 Handlooms and 50 Power looms are functioning. There is potential for taking up Eri-culture in Amravati, Yavatmal, Buldana, Nagpur, Wasim and Wardha districts of Vidarbha region. Tasar rearing is being practiced in Bhandara, Chandrapur, Gadchiroli, Gondia and Thane districts.

Table;The present status of Sericulture in the state of Maharashtra

Mulberry

Sr.No.	No. of District	Area under Mulberry (Acre)	Cocoon Production (MT)	Raw Silk Production (MT)	Employment Generated
1	22	10450	1744	200	60,000

Tasar ;

Sr.No.	No. of District	Area under Tasar (Ha.)	Cocoon Produ. (No)	Raw Silk Produt. MTs	Employment Generated
1	4	Economic-1100 Hect. Natural–15000 Hect.	180 lacs	8.00	9000

3.Why sericulture :

Sericulture in modern day terminology is best described as an activity with a rural-base and global reach

Sericulture can generate employment of 11 man-days per kg of raw silk produced in a year in associated upstream and downstream activities. In ecocomy agriculture is the dominant sector in employment providing work to around 10.7 % of the population and accounting for about 45% of the GNP. Sericulture is the labour –intensive industry in all its phases,

An important future of the sericulture industry is very high proportion (about 53 %) of female labour involved in silkworm rearing and cocoon reeling.

The potential of the sericulture is multifold and is yet to be fully tapped in our state

1 Employment generation in rural and semi urban areas , in tribal areas and both agricultural and industrial sector
2 Increasing production and productivity
3 Increased export through value addition.

Cost benefit analysis of mulberry sericulture and other competing crops (per acre per annum)

Item	Mulberry Sericulture	Sugarcane	Turmeric
Total in pull cost	48656.00	30575.00	29610.00
Gross returns	96132.00	60200.00	55317.00
Net reurns	47476.00	29625.00	25707.00
CB ratio	1:1:98	1:1:97	1:1:02

Advantages of mulbery sericulture over other cash crops :

Item	Mulberry Sericulture	Sugarcane	Turmeric
Crop loss due to pests and clusters	Less	Moderate	High
Cost of cultivation	Moderate	Low	Low
Risk factors	Less	Moderate	High
Price fluctuation	Less	Moderate	Moderate

4.The future policies 0f silk production in Maharashtra:

1. To enhance the production of raw silk through vertical and horizontal expansion of mulberry and non mulberry silk.
2. Augmenting effort for the spread of Mulberry bivoltine silk
3. To create greater opportunities for gainful employment in rural and backward areas especially for women and other marginal sections of the society.
4. To produce high quality silk of international grade for increasing export earnings.
5. Straightening of post cocoon sector in state
6. Encouraging cluster activities of reeling and weaving and strengthening linkages between the producer and the industry.

7. To improve productivity and quality at all levels of production processes starting from leaf production to fabric weaving through technological interventions, skill up-gradation and integrated extension support.
8. To build state of the art silk reeling processing and finishing capabilities.
9. To create market avenues through brand networking and promotional campaigns within and outside the country.
10. To promote the formation of self-help groups, quality clubs, clusters, societies of user groups, Sericulture polyclinics, co-operative societies etc. In the Silk Sector leading to capacity building at micro-level.
11. To involve the Panchayat Raj / Rural institutions in identifying beneficiaries and delivery of services to the sericulture farmers.
12. To sensitize Bankers and other financial institutions for augmenting the flow of credit to the Silk sector.
13. Recognition to silk as Maharashtra silk.
14. Introducing and encouraging corporate sector involvement in sericulture in line with contract farming with assistance from Central and State Govt.

5. Strengths and challenges of Maharashtra silk industry

Strengths:

- Comparative advantages such as production base, availability of skills, land and labour, easily adaptable technologies.
- Comparatively low investment and higher returns vis-à-vis other agricultural crops
- Short gestation period
- Favorable agro-climatic conditions and New sustainable tropical technologies
- Strong domestic market, since silk is a part of our culture and recognized as a symbol of purity – one product viz., sari consumes over 85% of silk produced and sari as a garment is one of the most elegant dresses in the world,
- Being a natural fiber enjoys increased patronage in the highly Eco-friendly and environment conscious world,
- Silk is exclusive considered as a luxury item along with gems and jewelry. It would therefore enjoy the support from the upper strata and growing middle class of the Indian society.
- Silk saris with silver and gold threads are always in demand through the marriage and festival seasons. Silk is an important bridal wear,
- There appears to be no dearth for traditional sari designs for creating exclusive items,
- Hand woven silks are extremely popular in the west and export markets are wide open with no threats of quota like other fibers,
- Silk is only less than 0.2% of the total textile fiber production and this present share is expected to decrease with sharp increase in production of other fibers. This situation would maintain an increase in demand for natural silk,
- With light weight silk becoming popular for dress material and printed saris, the market for silk is getting broad based within the country,
- The Indian silk Industry with handlooms and power looms is well equipped to handle small orders with short delivery schedules,
- Availability of indigenous technology at low cost.

Challenges:

- The basis stakeholders of the industry such as rearers, reelers, weavers, dyers and printers do not have sufficient funds to invest to renovate new machinery's and devices. The obsolete and outdated equipment's used presently does not permit quality production and is also not efficient for cost control,
- Thin margins and inadequate supportive systems for yarn disposal, absence of quality focused processing infrastructure for weavers, dyers and printers
- Being a highly labour intensive activity associated with poor technology, cost control and quality control are difficult,
- No quality based pricing system in market,
- Lack of stability due to frequent price fluctuations,
- The inability of the silk industry to react to the changing needs in terms of quality in the domestic and export markets is a major area of concern,
- Increasing quality awareness in the domestic market could pose a serious threat unless appropriate interventions to meet the requirements are planned,
- Dwindling water resources, deficient rainfall, raising global temperature and conservative laws.

6. The thrust area :-

There is big gap of demand and supply of silk in Maharashtra itself. The demand of raw silk is about 150 to 200 MTs. And presently the state is producing 76 MTs The silk is especially consumed in Maharashtra for production of PAITHANI (a poem in gold and silk) sari from Aurangabad. GADWAL sari from Solapur. PITAMBARI as well as PAITHANI sari from YEOLA Dist Nasik and TASAR (KOSA SILK from Bhandara Dist.) Tasar has a monopoly in Maharashtra and has export demand but we could hardly match to it.

To meet the demand of silk in coming years we have to have sericulture activity on 50000 hectares of land however, Directorate of Sericulture of Govt. of Maharashtra has a limitation to have such a huge expansion therefore it is proposed to adopt following approach.

Pre-cocoon sector:-

1 Increasing mulberry and non mulberry area.
2 To encourage private public partnership in sericulture i.e. having contract farming by corporate sector.
3 Intensive cluster development approach.

Post-cocoon sector:-

1 Promoting post cocoon industry and support in the area of Reeling,

Weaving and Garment/ fabric production.

2 Thrust Area – Improvement in raw silk Quality, Availability and Pricing:

It is essential to increase the number of Multi-end reeling units in the field for increasing the availability of good quality silk of international grade in sufficient quantity. Further quality improvement is to be caused through the introduction of 20 end slow speed multi-end reeling and semi automatic reeling machines in identified clusters and introducing denier control mechanism to Multi-end reeling machines. Establishment of large size units, say, 30-40 basins capacity would ensure availability of at least 30 Kgs lot (one carton) of uniform quality and price, a backward integration with farmers is necessary leading to meaningful exploitation of scale and scope economies. Contract farming that is being discussed for quite sometime should be made a reality.

3 Thrust Area – Up gradation in the Silk Twisting Sector:

Establishment of larger units with modern up twisters and TFO twisters are to be encouraged to benefit from the scale economies as also cater to the requirements of large weaving units. Such twisting units need to be set up in identified industrial areas in the proximity of handloom and power loom clusters. The power loom and handloom co-operatives may be encouraged to modernize their twisting and warping facilities with substantial subsidy on machines.

4 Thrust Area – Up gradation in Silk Handloom Sector:

Most of the handlooms have outlived their life and have poor infrastructure support in terms of newer designs and card cutting facilities. The government should consider evolving a scheme to replace the existing handlooms in a phased manner so that improved handlooms could be used for quality improvement and enhancing design possibilities.

Cluster based approach can be devised for up gradation of 3 or 4 identified silk handloom clusters and these clusters are strengthened with all possible technology support by way of improved looms ideally suited for specific clusters. Machinery and equipment for pre-loom operation are to be provided for more efficient functioning. The pre-loom operations include dyeing, rewinding, warping and pirn winding.

5 Thrust Area – Up gradation in the Silk Power loom Sector

6 Thrust Area – Up gradation in the Processing Sector (Mulberry Silk)

7 Thrust Area – Tasar Silk

Reeling and post-reeling operations need to be strengthened in these sectors. Silk enhancement training in adopting standard processing conditions and work practices need to be focused for achieving the full potential of the better technology already placed in the field, besides encouraging further improvements however small they are. Common facilities for cocoons drying, cocoon cooking, re-relling, skeining facilities are to be provided.

8 Thrust Area – Processing & finishing facility for non-Mulberry *(Vanya)* Silk

Processing and finishing facility for *Vanya* silk is very much essential to meet the demands of the export market in terms of colour fastness and proper finishes for

more functional end uses. This intervention with appropriate machinery can cause a significant increase in the demand for *Vanya* silks in the export market.

9 Thrust Area – Better return from the product – Dupion Silk Reeling Technology

Proper utilization of by-products of reeling industry for improving the revenue assume vital importance. For production of superior quality raw silk a thorough sorting of cocoons is essential. The sorted out (defective) cocoons can be more remuneratively made use of by producing dupion raw silk, which has good demand in the market. CSTRI has developed a dupion reeling machine to enable production of high quality dupion silk comparable to the imported variety largely being consumed by the exporters. This quality of dupion silk will be a substitute for the imports.

7. Proposed areas for sericulture development as a part of textile policy:

Package for cocoon sector:

1. To enrich the sources of availability of improved variety mulberry seed cuttings required for expansion of area under mulberry through raising of healthy saplings.
2. To enhance cocoon production by way of increasing mulberry wealth in the form of tree plantation.
3. To increase the dfls up take of farmers by increasing the quality leaf production through rejuvenation of existing mulberry tree plantation.
4. To enrich the source of availability of improved variety saplings required towards quick replacement of old and low yielding mulberry varieties with improved varieties at farmers level besides expansion of area under mulberry plantation.
5. Conservation and efficient management of water for the effective utility towers higher production per unit area of mulberry garden by adopting appropriate usage technique.
6. Introduction of the new mulberry Seri culturists to appropriate technologies through supply of a set rearing and farm appliances to begin the silkworm rearing activity.

8. Strengthen of post cocoon technology by - :

1. Promotion of efficient and modern machinery for (Multi-end reeling machines and Automatic reeling machines) production of international great silk.
2. Production of modern machinery and technology for production of good quality Dupion Silk.
3. Technological improvement in Charkha reeling to eliminate menace of child labour.
4. Strengthening of trusting sector through changing over to two for one twisters technology.
5. Strengthening of weaving sector by introduction of Auto looms.

6. Establishment of common facility centers for support services like dyeing ,weaving and by producer utilization.
7. Design development and product diversification.

9. Package for post cocoon sector:

Reeling forms a vital link in converting the agricultural produce viz. cocoon into an industrial product the yarn. The reeling sector in India is cottage based and highly decentralized, employing a variety of reeling devices such as cottage basin and to some extend multiend machine. The cottage basin sector contribute to 75% of the total raw silk produced in Maharashtra. The reeling industry in Maharashtra is mainly in Govt. Sector. The upper end of the reeling technology has multi end semi automatic and automatic reeling machines CSRTI multiend Reeling machinery package was introduced as the most technology to handle the available quality of cocoons to produce readable quality raw silk.

10. Strategies to be adopted:

1) Promoting contract farming in Mulberry Plantation, Silk Worm Rearing and Cocoons production.
2) Offering Higher Incentive to the farmer will be doing in Sericulture as compared to other agriculture crops.
3) Offering incentive subsidy in the area of Post Cocoon Technology i.e. Reeling and Weaving etc.
4) Declaring State of Sericulture as a Mission by giving the Priority to this Sector.
5) Developing Soil to Silk and Silk to Fabrics by adopting Textile Silk approach.
6) Offering SEZ like incentive for development of silk, like exemption in income tax, VAT etc.
7) As a result of above approach and policy in development of silk will generate an employment of 5 Lacks, specially to rural people thereby preventive Rural to urban migration.

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SECTION 5
POSSIBILITIES FOR USING SILKWORM AND MULBERRY FOR NON-TEXTILE PURPOSES

COMPARISON ON ANTI-OXIDATIVE CAPACITY OF VARIOUS SILKWORM STRAINS

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(POSTER)

To increase utilities as functional materials, 173 strains of silkworm genetic resources were evaluated on antioxidative capacity. The antioxidative capacity of silkworm powder was investigated with minilum L-100 device and ARAW-KIT (anti-radical ability of water soluble substance), in comparison to the ascorbic acid. Silkworm powder was prepared with freezing method at 5th instar 3rd day. All strains of the 80% methanol extracted with 30sec. vortex mixing solutions from the powder was used for the measurement. The data of pupation rate, longevity of silkmoth with origin and voltinism were used for data base of silkworm genetic resources. The weight of a silkworm larva with freezing method at 5th instar 3rd day was measured. The average of antioxidative capacity of 173 silkworms strains was 429.68nmol. The analysis of correlation among variables was significance as negative correlation of the antioxidative capacity with longevity of silk moth and weight of 5th instar silkworm larva. The tropic, Europe and others with origin of strain were comparatively high. In conclusion, short longevity and light of larval weight of 5th instar silkworm showed comparatively effective antioxidative capacity

Keywords: Silkworm, Antioxidative capacity, Longevity.

MULBERRY WOOD ART- A NEW VALUE ADDED BY-PRODUCT

By

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In India, mulberry is often compared with coconut tree, as none of its parts go waste and can be used in various ways to benefit farmers. Like silkworm cocoon handicrafts such as garlands, bouquets , toys, greeting cards etc, which have not only added value to sericulture but also become a small scale industry for many jobless, uneducated women in rural India, mulberry wood art is a new concept that has potential to be a value added product for art lovers. Repeated pruning of mulberry plants and trees makes the branches take curious turns

and shapes. White ants eat away a lot of soft tissues leaving the hard wood an artistic look. With a little artistic mind and approach one can convert these dried and curiously shaped wood pieces into fine art materials of various shapes.

FEASIBILITY OF APPLICATION OF COARSE MULBERRY LEAF GATHERED IN LATE AUTUMN AS FODDER FOR CATTLE BREEDING

By

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Feasibility of application of coarse mulberry leaf gathered in late autumn as fodder for cattle breeding is one of the unique properties of mulberry plant. Investigation of the problem was started by the authors at the v. Merisi, Keda region, Adjarian Autonomous Republic (Georgia) in 2000. At the background of economic conditions of the population of Adjara, especially those in "Upper Adjara", great significance is attributed to the development of sericulture as such and the development of a system of scientifically substantiated measures for application of wastes and inculcation of the system in practice, more so as the population of mountainous Adjara has rich traditions in preparation-storing of sprouts of beech, hombeam and linden in autumn to be used in winter as fodder for cattle.

In 2008 farmers of v. Merisi were offered free 350 mulberry saplings to be planted in their husbandries not only for restoration of fodder base for sericulture, but also for protection of soil from erosion and for filling in the fodder base for cattle. In 2010 mulberry leaf samples were taken for biochemical analysis and nutritive value of leaf stored in autumn was determined according to the periods, together with energetic nutritive unit and energy of metabolism.

This year mini-feeding of mulberry silkworm will be performed, optimal terms will be defined for storing coarse leaf in autumn and relevant technology will be developed; economic efficacy of fodder production will be determined and the principles of rational coexistence of sericulture and sheep (goat) breeding will be determined considering region peculiarities

Keywords: mulberry, leaf gathered in autumn, against erosion, Upper Adjara