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INFLUENCE OF HEAVY METALS ON COCOON *BOMBYX MORI* L.

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Abstract

The silky butterfly with its high sensitivity can successfully be used as a bioindicator to detect environmental pollution. A major source of heavy metal pollution is large industrial plants for ferrous and non-ferrous metals, as well as ore extraction and ore mining companies. In such an area, the mulberry garden is a source of food for the experimental groups. Bombyx mori L are fed with mulberry leaf with a high content of heavy metals reared in the most polluted area of the Non-ferrous metals Plovdiv. This study is part of many years of scientific research in the field. The high content of heavy metals inhibits the development of traceable biological features. Significant differences in results between control and trial groups were found.

***Key words**: Bombyx mori L., heavy metals, feeding, dirty leaves, silk cocoons.*

INTRODUCTION

The species *Bombyx mori* L. is hypersensitive to chemical contamination. *Bombyx mori* L suffered huge losses from poisoning by pesticides and heavy metals. Larvae can hardly overcome chemical poisoning, and most of them die.

Mamedova (1971) experiments with leaf-powered silkworms pretreated with copper and phorone salts and their mixtures, and establish an increase in yields of cocoons from one can of seed and an increase in the length of the silk thread. Positive impact on butter fly reproductive capacity and larval vitality is observed. The same author found a decrease in larval vitality, a reduction in the weight of cocoons and pupae, and a significantly lower consumption of iodine-treated mulberry leaf. Macro and trace elements are important for the development of such processes as maintaining a constant pH in the body. Deviating in one direction or another causes disturbances in the function of the enzymes (Babenko, 1965).

Populations of *Bombyx mori* L. of mono- and bi-voltinal origin are relatively higher in productive potential, but with lower tolerance to adverse environmental conditions (Murakami and Ohtsuki, 1989).

Macya (1983) found age differences in inhibitory doses of first to fifth larvae for the Co and Ni contents at 200 to 800 ml for these elements. In larvae that have taken larger amounts, a lethal effect caused by intoxication is observed. Thangavel (1990) finds that when larvae of *Bombyx mori* L. are fed with copper, magnesium and iron-treated leaves and their salts from rainwater, the metabolic activity of the larvae is stimulated, vitality and rotation increase. Increase the number of eggs laid in one piece. The percentage of silk increases by 2-4%.

In silkworms there is age sensitivity to heavy metals and pesticides. With increasing age, resistance increases. They are resistant are in the last fifth age.

According to Miyoshi (1971, 1978), high concentrations of heavy metals in food have a toxic effect on the silkworm. According to the same authors, the toxicity of heavy metals depends on the extent of their absorption in the intestine.

The silkworm (*Bombyx mori* L.) has the ability to accumulate large quantities of heavy metals in its organs without significantly affecting their development.

Our country owns one of the richest genetic resources of a silk butterfly. High-productive breeds and hybrids have been created in the SAES – Vratza. Our country has deep traditions in this direction. In the past, the cultivation of silk larvae was mainly directed towards the production of silk and silk products.

In the twentieth century, larvae were used as laboratory animals in a number of countries,

and in the present century as effective autotransplants, biosensors, silk chips and surgical sutures in medicine.
These facts reinvigorate the cultivation of silk larvae not only for the production of expensive silk fabrics but also as a producer of valuable products for other branches of the light industry and the high technologies in medicine and pharmacy.
Each stage of the metamorphous development of *Bombyx mori* L. - from egg to butterfly gives products that can be used and used in other industries. Even the butterfly itself is used in the pharmaceutical, cosmetic and food industries.
Silk larvae have been successfully used as a bioindicator and to identify environmental pollution with insecticides because of the insect's high sensitivity to them (Zlotin 1995).Literary sources indicate as good bio-indicators of environmental status of mulberry trees and silkworm larvae. The silk larva has been successfully used as a bioindicator and for detecting environmental pollution with insecticides due to the high sensitivity of the insect to them (Zlotin 1995).
Zhou (2015) in his studies tracks the accumulation of Pb in the feed chain soil, mulberry, larva. Heavy metals enter the leaves, and from there in the body of the fed silk larvae.
Harmful elements accumulate in the body where they are retained, some of them are excreted with excrement without passing into the final product - raw silk.
Mamedova (1971) conducted an experiment with leaf-treated silk larvae treated with copper and pine salts, and established an increase in the number of cocoons from one box of eggs and an increase in the length of the silk thread.
A positive influence on the butterfly reproductive capacity and the vigor of the pupation rate.
The same author finds a decrease in pupation rate, a reduction in the weight of cocoons and pupae, as well as a significantly lower consumption of iodine-treated mulberry leaf.
Shoukat (2014) monitors the accumulation of chromium (Cr) with a concentration (100 mg / l) and the toxic effects on the life cycle and growth of the larvae. It accumulates in the silk gland, the cuticle and the digestive canal. The author concludes that high chromium (Cr) inhibits the proper development of larvae and reduces silk yield. These results are close to that found by Khan (2009). According to the author, the accumulation of lead (Pb) in the body of the larvae reduces the production of silk.
Arnandova and Grekov (2003) also reported increased mortality with increasing accumulation of heavy metals in the bodies of insects.

MATERIAL AND METHODS

The study was conducted in the experimental base of the Agrarian University of Plovdiv. For controlled feeding of the larvae, leaves from the garden of the Agrarian University - Plovdiv, which is located outside the pollution zone (more than 10 km).
The experimental groups were fed with leaves of mulberry garden near. Experimental groups are fed with heavy metals contaminated leaves.One of the most polluted heavy metals in the country.

Objects of experimental work

The subject of the study is industrial hybrids of *Bombyx mori* L. and mulberry (*Morus alba* L.) as the main feed for larvae grown on highly contaminated soils.
The larvae of the hybrids (Super 1 x Hessa 2 and Baxa 1x Svila 2) were grown under controlled regime and observing technology for different ages. Observation of the larvae was performed using the standard technology (Grekov et al., 2005), during the spring season - May. All hybrids were grown in 4 replicates of 200 larvae counted after a second sleep. The information on the values of the main productive signs is taken according to commonly accepted methods (Grekov et al., 2005).
The larvae of the mulberry silk butterfly are fed three times a day with equal amounts of contaminated mulberry leaves.
We followed these quantitative characters:

- cocoon weight (mg);
- fresh cocoon weight(mg);
- filament length (m);
- filament size, g/denier,
- silk ratio (%).

High-performance hybrids C1xX2 and B1x2 were used, characterized by all the values of the main biological features. For the purposes of

the experiment, the cocoons obtained from the two hybrids (ClxX2 and Blx2) were analyzed for the main features determining the yield of silk worms. A medium sample of dried cocoons was formed for the technological characteristic of the cocoon and the silk thread of each iteration. The weight characteristics of the silk envelope and the cocoons are determined by weighing with an electronic scale (precision 0.001 g).
The length of the silk thread (m) is determined by cocoon drawing. Laboratory yield of raw silk (%) is determined individually for each cocoon:

RESULTS AND DISCUSSION

From Figure 1, it can be seen that the values of the investigated signs between the test and the control groups differ significantly.

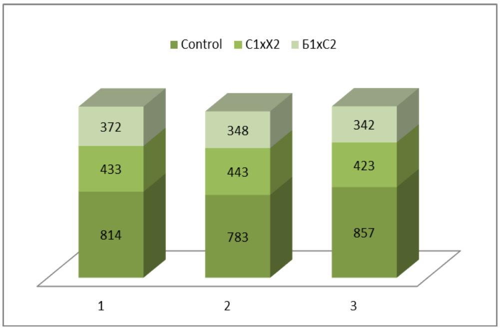

Figure 1. Cocoon weight (mg)

The cocoon weight (Figure 1) and the weight of the cocoon thread (Figure 2) are actively involved as elements of productivity. For these signs, the values are lower than the control.

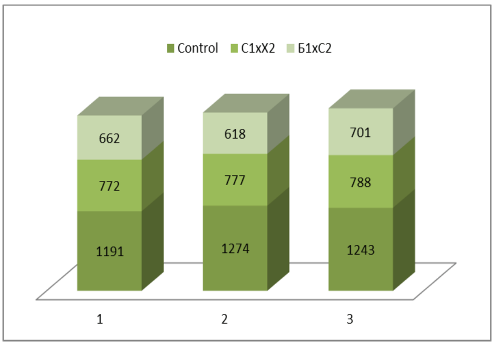

Figure 2. Fresh cocoon weight (mg)

In larvae fed with pure leaves, the cocoon mass values are from 783 to 857 mg and signify-cantly lower in the variants fed with contaminated leaves.
The technological features of the silk thread have greatly contributed to forming the quality of raw silk.
Here again, the values are comparatively lower than those observed in control groups fed with pure mulberry leaves.
Larvae fed with dirty leaves, turn cocoons with a lower weight, which affects the thread.

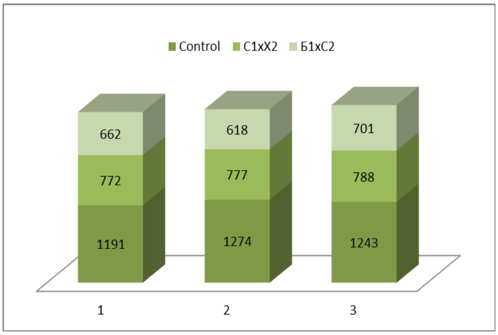

Figure 3. Filament length (m)

The most significant differences between the groups were reported in the length and mass of the cocoon thread Figures 3 and 4. In the test groups, the attribute values ranged from 618 to 788 m of thread length and significantly longer in the control groups from 1191 to 1274 m. Signs is heavily influenced by the presence of heavy metals in the mulberry litsa.

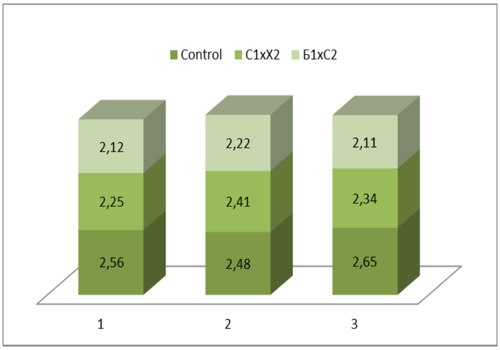

Figure 4. Filament size, g/denier

No significant differences in the values between the groups are observed in the Filament size.

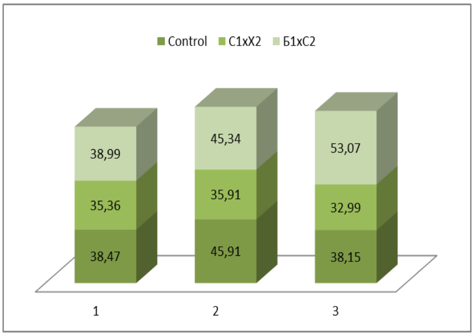

Figure 5. Silk ratio (%)

The signs of filament size and silk ratio are less affected by the presence of heavy metals in the diet. Even so, there were observed differences from the adverse effects of heavy metals.

CONCLUSIONS

From the results obtained, the following conclusion can be drawn:

The high content of heavy metals inhibits the development of trace able biological features. Significant differences in the results between the test and control groups were found for some of the signs, others were poorly influenced.

Significantly influence the presence of heavy metals had on the length and weight of the filament, and the less in the thickness of the thread and in the silk ratio. The results we have come close to those of authors such as Miyoshi (1978); Masui and Matsubara, (1984), Grekov (1995), Cenov (1997) and Petkov (1999).

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