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Zoology

Structural Peculiarities of Caterpillar's Cuticle of *Archips podana* Sc. (Lepidoptera, Tortricidae)

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ABSTRACT. The species *Archips podana* Sc., very interesting from the economic point of view, has been studied by the method of light and electron microscopy. In Georgia the subspecies of the species *Archips podana meridiana* Kozlov et Esartia is spread. The authors pay attention to epicuticle, exocuticle and endocuticle. In each case 5 different parts of caterpillars of *Archips podana* Sc. have been investigated. It is shown that epicuticle in different ways is presented in back and anal parts of Tortricidae caterpillars. Submicroscopic data are proved by the method of laser diffractometry. Special attention is paid to porous canals, their structural functional indices, which play an important role in the action of insecticides'. *© 2008 Bull. Georg. Natl. Acad. Sci.*

Key words: *Archips podana* Sc.*, caterpillar, cuticle.*

As is noted by a number of authors [1-6], the structural indices of *Archips podana* Sc. have not been sufficiently studied so far.

The aim of the work was to study 70 specimens by light and electron microscopy. The material for light microscopy was fixed in Carnua liquid, then poured into paraffin and cut on the microtome of Richert Firm. The cuts were examined in the light microscope of photomicroscope type III, Opton (Germany). Material for electron microscopy was fixed in 1% solution of looked through osmium on buffer, poured into epon and cut on ultratome OmU_2 (Austria). The cuts were in electron microscope BS-500 type, Tesla (Czechia) at the accelerating voltage 80 kV. Negatives were treated by the method of laser diffractometry (D-17). In total 70 specimens were investigated. In each case experimental material was studied in five different segments of Lepidoptera Tortricidae caterpillars.

As the investigations show the study of covering tissue of *Archips podana* Sc. reveals that the whole body is covered by cuticle, which forms the outer skeleton of the caterpillar and is divided into two basic layers: thick inner one – procuticle, consisting of endocuticle and exocuticle - acccording to electron microscopic observation is presented by double layer membrane, in which both layers follow absolutely parallel to each other. Only in some places the epiblasts separate and form small cisterns.

At the same time inhomogeneos osmiophility of the epiblast of the epicuticle draws attention. Outer epiblast of epicuticle is more osmiophilic than the inner one. The epicuticle's surface is especially strong in the middle segments of Lepidoptera, Tortricidae than in the ends. The thickness is absolutly homogeneous on the whole surface of caterpillar of the *Archips podana* Sc. (Fig.1).

As to the procuticle, which consists of two sublayers: exocuticle and endocuticle, the following should be noted. Porous canals piercing through the whole procuticle have the form of ellipsoid tubes. Moreover, when the canals are located nearer to the surface of epicuticle, then ellipsoid diminishes in diameter and

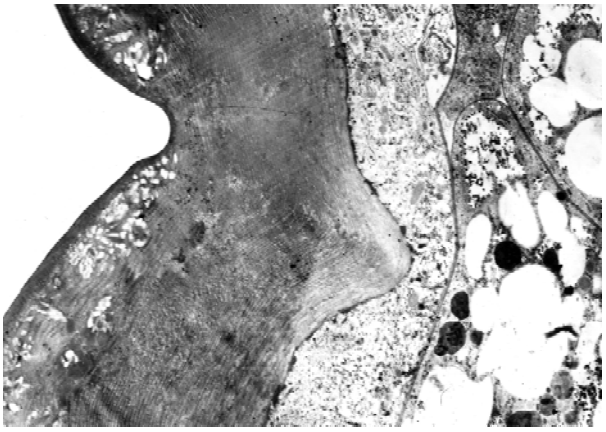

Fig. 1. Cuticle of the *Archips podana* Sc. caterpillar. Back part, epin and procuticle. Electronogramm. 25.000x.

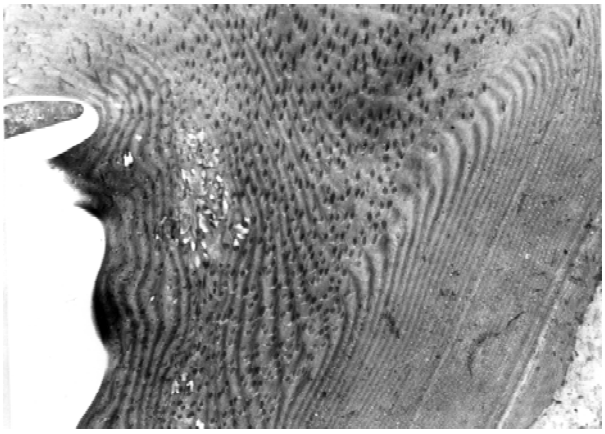

Fig.2. Cuticle of the *Archips podana* Sc. caterpillar. Anal part, porous canals. Electronogramm. 35.000x.

gradually the diameter of the canals becomes round. And, on the contrary, the diameter of ellipsoid in endocuticle increases (the canals stretch). From this it follows that porous canals become funnel-shaped. They start from epidermis and, going through the whole procuticle, they reach the outer surface of epicuticle. The very porous canals provide the connection of the ecosystem surrounding the caterpillars of *Archips podana* Sc. with all its inner systems. Synthesis and transportation of substances for the formation of the epicuticle layer is provided by means of the canals.

Porous canals have not straightforward but arcwise location. There are threadlike shoots of epidermal cells inside the porous canals. The porous canals take part in the synthesis and transportation of the substances forming the epicuticle.

Cuticle is an effective barrier for water molecules penetrating in the direction from procuticle to epicuticle. Due to cuticle - its functional asymmetry, active absorption of water through porous canals becomes possible. This phenomenon is connected with some peculiarities of the behavior of lipoid molecules involved in the structure of epicuticle (hydrophobic groups of lipoid molecules are outside and hydrophilic groups are directed into the body cavity of the caterpillar of *Archips podana* Sc.). From the above noted, cuticle reveals maximal hydrophility.

Porous canals, provided with long cytoplasmatic shoots of epidermal cells, take an active part in the process of water absorption.

Thus, it follows that the importance of epicuticle for transpiration is absolutely undoubted and is in direct dependence on the temperature indices and area of its body.

The level of development of epicuticle depends on the humidity and habitat, which determine the ability of the caterpillar of *Archips podana* Sc. to prevent drying (Fig.2).

The layer of the exocuticle is much larger than the layer of endocuticle. In the layer, composing exocuticle, layers of chitin-protein complex are clearly marked. They are presented by lamella plates, well observed under electron microscope. The plated structure of endocuticle conditions the rythmical activity of epidermal cells.

In the area of exocuticle the chitin-protein molecules are stabilized by quinone and pigments. That is, exocuticle can be considered to be a hardened procuticle having lost its primary plated structure.

Procuticle (exocuticle and endocuticle) is presented by different thickness in front, middle and rear parts of caterpillar of *Archips podana* Sc. It is thicker (especially in reference to exocuticle).

The cuticle and its morphological structure play an important role in penetration and connection with environment. The same connection is used by a number of researchers in order to increase the effectiveness of pest control in agriculture when applying insecticides. Most insecticides are poisons and that is why the ways of their penetration through cuticles are studied with the maximum attention. However, the developed epicuticle limits the penetration of coverings for most insecticides. Breaking the cuticle, first of all, its surface layer (epicuticle), the insecticides cause a change of the intensity of active and passive transport through coverings. Active transport of molecules through cuticle occurs in the direction opposite to concentration gradient and it requires the energy released by epidermal cells at breathing exchange.

Such factors as oxygen deficiency, accumulation of surplus quantity of carbonic acid, action of respiratory poisons do not influence passive transport of molecules but strongly complicate and slow the active transport.

Active transport of molecules changes the adsorbing capacities of chitin and may decrease the estability of caterpillars of *Archips podana* Sc. to toxic activity of insecticides.

It should also be noted that the above morphological peculiarities of caterpillars (namely, arc-shape of porous canals) can be used for diagnostics in the earlier stage of the species development.

ზოოლოგია

მუხლუხის (*Archips podana* Sc.) კუტიკულის სტრუქტურული ცვლილებები

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შესწავლილია მატლის კუტიკულა სინათლის მიკროსკოპის საშუალებით. სულ შესწავლილია მატლის 70 შემთხვევა. ავტორები დიდ როლს ანიჭებენ ეპიკუტიკულას, ეგზოკუტიკულას და ენდოკუტიკულას. კერძოდ, ყველა შემთხვევაში თითო მატლიდან აღებული იყო ხუთი სხვადასხვა ადგილი. ნაჩვენებია, რომ ეპიკუტიკულა სტრუქტურულად სხვადასხვა ნაწილში არათანაბრად არის წარმოდგენილი. სუბმიკროსკოპული შემთხვევები გაძლიერებულია ლაზერული დიფრაქტომეტრიის მტკიცებებით. ნაშრომში დიდი ყურადღება ექცევა ფორების განლაგებას, მათ რაოდენობას, სტრუქტურულ და ფუნქციურ მაჩვენებლებს, რომლებიც დიდ როლს თამაშობენ ინსექტიციდებთან ბრძოლაში. ნაშრომი ატარებს გამოყენებით ხასიათს.

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