Research on Pest and Pathogen of green Plantings of Tbilisi, Georgia

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Abstract

Environment protection is a very difficult and important problem and it covers many interconnected aspects. Among these aspects green planting management of a modern city is to be mentioned. Since green plantings are a sort of "lungs" of a city, therefore, especially today it is important to protect them from damage by pests and diseases. Our aim was to carry out a pathological research on green plantings of Tbilisi and to estimate a condition of the most common plants on this territory. With this end in view it was necessary to study the species composition of the pests (insects and diseases) on plants in Tbilisi plantings (parks, squares and roadside areas). The pathological monitoring of plants has been carried out in various districts of Tbilisi; visual observation has established that the plants of planes and box tree were the most damaged species. The detailed research also has revealed the pests: sycamore bug *Corythucha ciliata* and box tree moth *Cydalima perspectalis*. The bushes of box tree also were diseased by the phytopathogen organisms *Volutella buxi* and *Alternaria alternata.* Frequency of spread of plant pests and diseases, their pathological status, and condition have been studied.

Key words: *Platanus orientalis, Buxus colchica, pest insect, disease.*

Аннотация

Защита природы – трудная и значительная проблема, которая содержит много связанных между собой аспектов. Один из таких аспектов – проблема сохранения зеленных насаждений в современных городах. Так как зеленные насаждения «легкие» города, особенно важно защитить их от разных болезней и вредителей. Нашей целью является проводить патологическое исследования зеленных насаждений города Тбилиси и выявление патологии значительных растений на этих территориях. Для этого нужно было выявить видовой состав вредителей (насекомых и болезней) на растениях в Тбилисских парках и скверах. Патологический мониторинг растений был проведен на разных участках г. Тбилиси. Было выявлено, что самыми зараженными были деревья платана и самшита, после детального исследования были выявлены вредители: Платановый клоп-кружевница *Corythucha ciliata* и Самшитовая огневка *Cydalima perspectalis*. Самшит был также поврежден фитопатологическими организмами *Volutella buxi* и *Alternaria alternata*. Была изучена частота распространения вредителей и болезней, их патологический статус и состояние.

Ключевые слова: *Platanus orientalis, Buxus colchica, вредители насекомые, болезни.*

Introduction

Tbilisi is a city where high variety of different plant species is represented at the recreation and landscape sites (Kurashvili, 1983). Among them forest plant species are distinguished by their biodiversity. These plants are very important from economical and technical, sanitary and hygienic, recreational, etc. points of view. So it is essential to keep them in a healthy condition, but unfortunately due to suitable conditions periodical outbreaks of pest insects and different diseases of plants occur, that cause damage and often even drying of affected trees in parks, squares and other recreational territories. Researches must be conducted to reveal the problems concerning plant pest and diseases to carry out timely protection measures.

The entomologists who lived in the Caucasus were always interested in the study of pests of green plantings of Tbilisi. The first information about harmful insects of squares we found in the A. Ardasenov's (1888) works. Later pests of woody tree species and the harmful insects of green plantings of Tbilisi were studied by Lozovoi (1941, 1948, 1949, 1954, 1957, 1961) and Zhizhilashvili (1947, 1952). Phauna beetles and defoliators in Tbilisi and its outskirts were researched as well (Seperteladze, 1968). There were studies on methods of insect control at parks of East Georgia (Khadjibeili, 1955, 1956), entomo phauna of outskirts of Tbilisi was investigated by Tcholokava (1968) and others.

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The aim of our study was to carry out research on pathological plants, to reveal harmful pest insects and diseases at landscaping of Tbilisi city and assess the status of plants most common at these territories.

There are different woody plant species in green planting of Tbilisi. Plane tree *Platanus orientalis* L. is the most frequently plant in Tbilisi landscaping – in gardens, parks, squares, roadsides. Plane tree is a wind firm plant, it is the best in urban development – due to its decorative value and very high resistance to atmosphere pollution. Plane trees are a valuable part of the urban landscape, providing many ecosystem services. This commonly planted street tree tends to be very tolerant of the harsh conditions imposed by urban environments but there is increasing awareness of a number of pests and pathogens that affect *Platanus* (Tubby, Pérez-Sierra, 2015).

Box tree-*Buxus colchica* Pojark is also widely used in green planting of Tbilisi. It must be mentioned that it is introduced in the Red Book as the unique endemic species in Georgia (Gigauri, 2000).

We have revealed on plane trees the imago of the insect sycamore lace bug *Corythucha ciliate.* Pest is widely spread in different countries. Several consecutive years of severe lace bug damage, combined with other stress factors, may kill host trees (Halbert, Meeker, 2001). Among investigated plants bushes of box tree were heavily damaged by larva of box tree moth – *Cydalima perspectalis*. This insect originates from East Asia (China, Japanand Korea) and was first discovered in South-western Germany and the Netherlands in 2007. *Cydalima perspectalis* most likely arrived via the trade of box plants (*Buxus* spp.) from Asia and within a few years, has become a serious pest of one of Europe's most popular ornamental shrubs. The moth has also invaded several natural *Buxus* populations in Central Europe (Kenis, Nacambo, 2013). Two different diseases of box tree – *Volutella buxi* and *Alternaria alternate* – have been also revealed.

Methods of research

Monitoring of visually damaged plants species was carried out in three different districts of the city Tbilisi. The visual observation of plants in all three locations, in roadsides the plane trees and also bushes of box trees in squares has revealed the most heavily damaged plants species. Therefore, we have carried out a detailed research only of these plants. A similar number of trees (ten plants for each species) have been studied in all areas. Materials were taken from lower, mid and upper layers of a plant. A quantity of harmful insects per running meter of box tree has been counted (Baranchikov, Bobrinski, 2014). For counting of imago of sycamore lace bug we used methods accepted in entomology, in particular, we counted the average number of the wintering phase of the insect, imago, on the area 1 dm^2 of bark being stripped off from the crown. In study of symptoms of the disease of plants its spread has been registered by the M. Stepanov and A. Chumakov's method (1972). The percentage of spread of the disease has been calculated by the formula (1):

$$P=n/Nx100, \quad (1)$$

where: P – is a spread of disease in %,

n – number of diseased plants,

N – the total number of studied trees.

The damaged material has been carried over to the laboratory for detailed study of insects and diseases, and they have been studied microscopically.

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Results and Discussion

It is to be mentioned that the green planting of Tbilisi is distinguished by diverse plant species. Plane tree, lime tree, ash tree and acacia take the lead in broadleaved species. Plantings of box tree are also interesting from the point of view of urban greening and also decorative value; they take a lead in squares and recreational territories of the city. Many scientists studied the phytophagous insects of green plantings of Tbilisi. It is established that the plantings of peripheral part of the city are distinguished by relatively less species composition; this may be explained by the fact that the natural cenoses of the city outskirts are remained in these areas; the predatory species prevailing there eat harmful insects and reduce the quantity of pests. The more diverse complex of insects is observed in the green plantings grown inside the city (Kurashvili, 1983)

Platanus orientalis and box tree *Buxus colchica* are very popular in parks and landscape planting of the city. As a result of phyto-sanitary monitoring we have established that in three different districts of Tbilisi (Saburtalo, Vake, Didube) visually the plantings of plane tree and box tree were the most problematic. Very frequent settlement of sycamore lace bug has been recorded on a plane tree. 70 % of the recorded trees were occupied by pests, though on 1 dm^2 of bark stripped off the crown 3–4 specimens of imago have been recorded on average. The colonies of pests have been mentioned in all three districts of the pathological monitoring (Fig. 1.).

Fig. 1. Adult of sycamore lace bug

Sycamore lace bug is an invasive species. It belongs to the order *Hemiptera*, it gives several generations, winters under bark or in closed or in indoor area. From the Northern America it spread almost in the entire Europe. In the end of the 20th century, in 1997 it was for the first time recorded in Russia (Voigt, 2001). And then from Russia it spread to Georgia (Gninenko, Supatashvili, 2008). In Georgia it occupies leaves of plane *Platanus orientalis*, though in Europe it occupies and damages also ash tree and maple. In its homeland – America- it prefers various species of plane tree (sycamore) (Pericart, 1983). The morphology of the pest, its systematic and biological data is studied.

As a result of monitoring carried out on box tree many colonies of box tree moth *Cydalima perspectalis* were revealed per each running meter of a branch of box tree: strong (more than 10 larva) and average (less than 10 larvas). The heaviest damage has been recorded on box tree leaves – 70 larvas per running meter (Saburtalo district)). 70 % of studied trees were occupied by the mentioned pest and as a result defoliation of plant was sufficiently high (Fig. 2.). The colonies of pests have been pointed out in all three districts of the pathological monitoring.

It is to be mentioned that conservation of box tree as unique endemic species is very important, but unfortunately, its area in recent years is being reduced (Tskhvedadze, Kereselidze, 2017). Supposedly, the box tree moth of box tree invaded Georgia from the western Georgia in 2013 and began fast spreading to the east.

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Fig. 2. Damaged leaves by *Cydalima perspectalis*

The box tree moth of box tree is an invasive species. In general, invasive insects are distinguished by strong harmfulness. They have less natural enemies that may reduce their population. The box tree moth of box tree invaded and settled in almost 16 countries in Europe and creates a serious problem to box tree. (Kenis, Nacambo, 2013) Surveys in Switzerland showed that the natural enemy complex in Europe is very poor. Larval parasitism was less than 1 % and represented by a single tachinid parasitoid, *Pseudoperichaeta nigrolineata* (Walker) while no egg or pupal parasitoids were found (Nacambo, 2012).

There are preliminary data on the parasitism of *C. perspectalis* in Europe, options for sustainable long-term solutions for the management of this invasive pest in Europe (Wan, Haye, 2014). With the aim of reducing of their population it is desirable in future to carry out researches in Georgia, in order to reveal its natural enemies. Then population of the pest will be regulated by environmentally safe biological means.

Our researches also have mentioned drying of leaves of box tree plantings. Symptoms were the following: round-shaped and brown-black color spots with size of 3–4mm of diameter on the leaves of plants, tips of some leaf were decolorized. Diseased twigs started to dry (Fig. 3.).

As a result of our investigation by sowing of pathogen on the artificial media (Saburoud dextrose agar and beer-wort agar) and microscopic analysis it was established that in pure culture fungus *Alternaria alternata* (Fr.) Keissler. was revealed with brown, bottle shaped multi- partition, small, elongated spores with size of 29-48X14-17μkm.

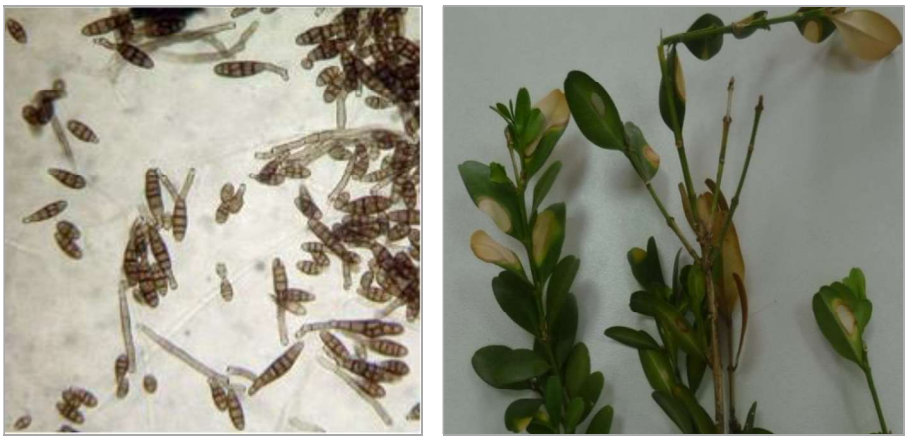

Fig. 3. Diseased leaves of *Buxus colchica* Pojark by *Alternaria*

Alternaria is one of the most spread fungus. It is among that ten which are most frequently met from 2000 genus of fungus. This genus consists of about 100 species, some of them are saprophytic (are spread in water, leather, paper, cut wood, cotton material, building material, stone

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monuments, etc.). Some of them are parasites, which can cause diseases of plants, animal and human (allergic reaction) as well. They settle and cause damage on wide spectrum of plants species among which are shrubs of the city, ornamental, decorative plants. Many species of *Alternaria* which are spread on plants cause their drying. So, problem with it on ornamentals is rather actual. It is studied abroad as well as in Georgia (Agrios, 2005; Sinadsky, et.al., 1982) but still needs further studies and researches.

We also recorded other kinds of damage of leaves, in particular, bronze spots were observed on leaves; the spots gradually expanded and turned white in the center and bronze on the boundary between healthy and blighted tissue. Light rose-colored sporodochia and white mycelium were observed on the abaxial leaf surface. Eventually, the diseased leaves withered and defoliated. Diseased leaves were collected and placed onto potato dextrose agar (PDA). After 1 day of incubation at 25°C, white aerial mycelia grew from diseased tissues. Later pink-orange sporodochia were observed in the middle of the colonies. Conidia were measured- average of 100 conidia: 5.85 × 3.14 µm. Pathogen was identified as *Volutella buxi* (Fig. 4.).

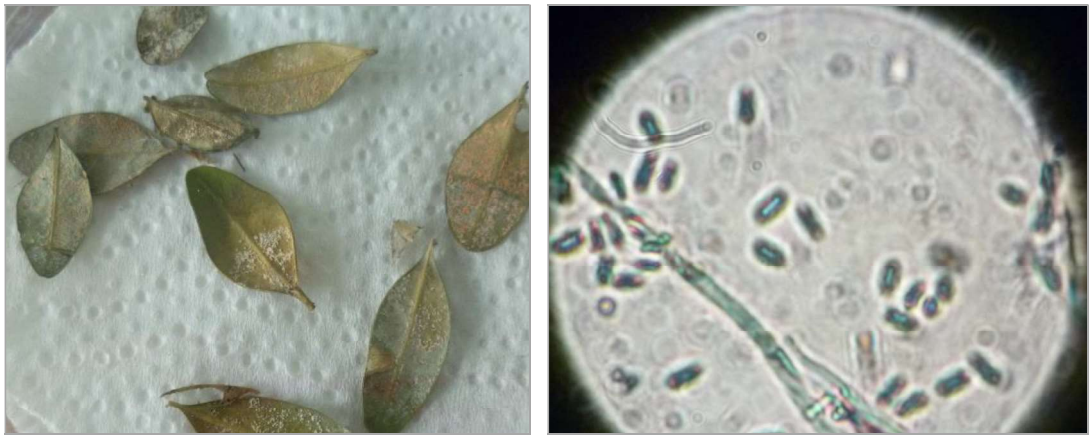

Fig. 4. Diseased leaves and spores of *Volutella buxi*

We have determined the percentage of spreading of both diseases – 30 % in the case of *Volutella buxi* and slightly more – 40 % – in the case of *Alternaria alternata.*

During pathological monitoring pests insects *Corythucha ciliata* and *Cydalima perspectalis* in all investigated plots were revealed, while diseases: *Volutella buxi* and *Alternaria alternata* only in one- Saburtalo district were mentioned (Table).

Table. Spread of harmful organisms at different districts of Tbilisi

District	Pests		Diseases	
	Corythucha ciliata	***Cydalima perspectalis***	***Volutella buxi***	***Alternaria alternata***
Saburtalo	+	+	+	+
Vake	+	+	–	–
Didube	+	+	–	–

Conclusions

The pathological researches on plants carried out in three districts of Tbilisi (Saburtalo, Vake, Didube) have established that visually the most problematic were the plantings of plane tree and box tree. The forms of imago of the sycamore lace bug have been revealed, the density of their settlement has been determined. The insect has been recorded in all three districts of the research.

We also have detected the damage of plantings of box tree affected by insect and pathogen organisms.

The spreading of the invasive insect-box tree moth – *Cydalima perspectalis* has been determined. Its harmfulness, density of population has been established. Out of phytopathogen

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organisms two fungal pathogens – *Volutella buxi* and *Alternaria alternata* – have been recorded. Their morphological characters have been studied and the percentage of spreading has been determined.

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Исследование насекомых и болезней зеленных насаждений г. Тбилиси, Грузия

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Резюме

Во всем мире большое внимание уделяется уходу за зелеными насаждениями. Этот вопрос значителен и для города Тбилиси, где парки, скверы и другие рекреативные территории представлены разнообразными видами растений. Из-за различных биотических и абиотических факторов растения ослабевают, на них населяются вредные насекомые, фитопатологические организмы, поэтому у растений выявляются признаки поражения, возможно высыхание растений. Поэтому обязательно своевременное выявление проблемы. Нашей целью являлся фитопатологический мониторинг растений зеленых насаждений, установить самые проблемные виды растений и изучить видовой состав вредных насекомых и болезней, распространенных на них. Исследование проводилось на трех различных участках г. Тбилиси. Визуально было выявлено, что самыми зараженными были виды платана и самшита. Платан – самое распространенное растение в Тбилиси, как на окраинах дорог, так и в парках и скверах, а защита самшита *Buxus colchica* Pojark имеет большое значение, так как он эндемный вид Грузии и занесён в красную книгу. Для мониторинга обеих видов были использованы по десять растений. Самшит был поражен личинками самшитовой огневки *Cydalima perspectalis*, а побледнение листьев было вызвано инвазивным насекомым –платановый клоп *Corythucha ciliata*. Учет проводился соответствующими методами, принятыми в энтомологии. В случае самшита, материал был взят с нижней, средней и верхней частей растения, посчитали личинки на один продольный метр ветки, а численность имаго платанового клопа было посчитано на 1дм^2 коры ствола дерева. На основе микроскопического наблюдения также были выявлены фитопатологические заболевания двух видов – *Alternaria alternata* и *Volutella buxi*. Был рассчитан % распространения заболеваний.

Нужно отметить, что платановый клоп – инвазивный вид. Он дает несколько генераций, зимует под корнем дерева или в других закрытых пространствах. С северной Америке он сначала попал в Европу, а потом в Россию и наконец, в Грузию. 70% деревьев, учет которых мы проводили, были населены этим насекомым – 3–4 шт. зимующего имаго на 1дм^2 коры ствола. Что касается самшитовой огневки, она так же инвазивное насекомое. 70% растений было населено этим насекомым и, соответственно, дефолиация была высокая. Микроскопическим исследованием были изучены морфологические признаки патогенов, выявленных на самшите. В случае *V. buxi*. распространение было 30%, а *A. alternata* 40%. На всех трех участках, изученных нами, были зафиксированы насекомые обеих видов, а заболевания выявились только на одном участке. Нужно продолжить патологические исследования и в будущем, чтобы своевременно выявить заболевания и провести защитные мероприятия.

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