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Biological and Ecological Features of the Fungus *Cladosporium Herbarum*.

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ABSTRACT

In 2014 fungus Cladosporium herbarum Fr. greatly affected on the aerial parts of Zea mays L. in the field on the right track side of Almaty Zhambyl area Uzynagash in Almaty region. Cornfield was completely infected. About 300 species of Cladosporium is described[6]. The most interesting from them is the following form which was discovered by us in a cornfield in Almaty region. Cladosporium herbarum Fr. is an imperfect fungus of the Dematiaceae family belonging to Hyphomycetales. Cladosporium herbarum Fr. damaged cultural seeds in special exploration and as a result we found highest parasitic property of it. It was made by the artificial way of N.I. Wasilewski (1984) where 14 seeds (7 grain seedlings, 7 vegetable and technical seedlings) were damaged.

Keywords: Zea mays L., Cornfield, Cladosporium herbarum Fr., infection.

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INTRODUCTION

Infectious diseases are caused by fungi. The main sources of the infection are the remains of infected plants, soil and infected seeds. In case of heavily infected seeds become dead and lose its significance as a seed. In case of the weak affected germination energy reduces, seedling and plant's development are later, crops are sparse; plants are weakened and therefore have sharply reduced not only the harvest, but also reduced their quality [1].

In view of the large number of Cladosporium conidia in the air it is not surprising frequent occurrence of species of this genus on a variety of substrates, where these fungi can get at least a small amount of nutrients [2]. They can grow in liquid fuel, lubricants, PVC-coated industrial products in countries with tropical climates, in paintings, paper, wood, on sporulation of some Basidiomycetes and marsupial fungi [3]. They grow well in low temperatures and are often found in meat products, butter, packaged fruit and vegetables that are in cold storage. In favourable conditions Cladosporium species multiplies rapidly, heavily populats the substrate, and makes a significant harm [4].

Picture 1. Cornfield, where Zea mays L. was strongly infected with Cladosporium herbarum Fr.

In view of the widespread of the species of the genus Cladosporium on plants and in the soil a lot of their spores are in the air. Especially a lot of them are in the summer, during the growing season (sometimes more than 40% of all detected in air fungal spores). In tropical air masses of spores reach 82.3%. Cladosporium is a well known trigger for asthma and is one of the most common forms. [5].

Marsupial sporulation is found only in two species of Cladosporium. They formed fruiting bodies perithecia type with a short cervix (genus Mycosphaerella and Amorphoteca). Bags in perithecia contain eight ascospores. [6].

About 300 species of Cladosporium is described [6]. Of them the most interesting are the following form which was discovered by us in a cornfield in Almaty region. Cladosporium herbarum Fr. is an imperfect fungus of the Dematiaceae family belonging to Hyphomycetales.

In 2014 fungus Cladosporium herbarum Fr. greatly affected the aerial parts of Zea mays L. in the field on the right side of the track Almaty Zhambyl area Uzynagash in Almaty region. Cornfield was completely infected (Picture 1). As a result the corn crop is not harvested and a large field has been left.

Cladosporium herbarum Fr. lives in the soil mainly on the plant debris and in the rhizosphere of the plants. It is abound in the forest floor, participating in its decomposition.

However, it's the concentrations are very low in the winter. In the summer, daily peaks can vary from 2,000 to 50,000 conidia per cubic meter in air. Concentration of conidia of Cladosporium species in the air depends on the condition of the infected plants, which are in an open or closed ground [6,7,8].

In 2009 study on fungi of the genus Cladosporium was conducted by the researchers from Pakistan and Estonia [9,10].

MATERIALS AND METHODS

Maize seeds from corn field of Dzhambul district of Almaty region were collected. Collected grain maize seeds were left in a humid chamber. At the bottom of the Petri dish filter paper was placed in a two layers and sterilized in an oven at a temperature of 130 C per hour. Also pipettes were sterilized. Sterile paper in Petri dishes was wetted by pipette with sterile water to complete hydration. Seeds were sterilized in 70% alcohol for 1 minute. Then they were laid out on the wet filter paper on the bottom of the Petri dish at a distance of 1.5-2 cm apart. The Petri dishes were kept at a temperature of 21℃. The growth and development monitoring was conducted on a daily basis. Sporulation of fungi on the seeds was formed on the seventh day. The nature and growth of mycelium is determined by the species belonging to the determinants of Naumov (1935), and Litvinov (1967). Then mycelial colonies of Cladosporium herbarum Fr. were passaged into Petri cups with a nutrient medium. At this fungus incubation Capek agar nutrient medium was used. The medium was dispensed into Petri dishes with even layer thickness of 3-4 mm. Fungi were sowed in the sterility. The growth and development monitoring was conducted on a daily basis. The presence of pure cultures makes it possible to determine the nature of growth and sporulation in Cladosporium herbarum Fr., especially morphogenesis, identifying development cycle and sporulation, to establish their relation to environmental factors (temperature, humidity, light sources, medium acidity.) etc. Then the spread of the fungus Cladosporium herbarum Fr. has been studied. Pure culture of the fungus was used as an inoculum and by the method of N.I. Wasilewski (1948) conducted a test of the parasitic properties of fungi inoculum that infected vegetative organs of grains and vegetable crops. For this, during the growing season collected aerial and underground organs of the examined plants put in Petri dishes and infected with an inoculum and kept in a moist chamber at 10 ° C for 7 to 14 days. Then they were transferred to the laboratory, where the air temperature is 21 ° C.

According to the results of the research an offer has been made which types of crops can be sown in the subsequent seasons on the corn field that is infected by the species of Cladosporium herbarum Fr.

THE RESULTS OF THE STUDY.

During the ripening of corn and other cereals, and especially in wet years olive-black velvety coating is emerging on the stalks, ears, grains and senescent leaves that seals and takes the form of a sod layer. Beams of olive-black conidiophores with conidia are formed on the mycelium. Conidiophores are simple; sometimes to the top are a bit many-tentacled, the thickness is-10 mkm (Picture 2). Conidia are lengthy, cylindrical, size 12-28x6-7 microns, first without septum, and later are 2-5 cells, strigillose, sometimes pullulated. Cladosporium herbarum Fr. is an obligate parasite with the prevailing features of the saprophytism. It is developing very fast on the aphid secretions, so when it strong breeding on the crops there is an enhanced development of the olive mildew stain. The delay with the wheat harvest in wet weather leads to a rapid spread of the disease and blackening the entire of the aboveground mass of plants. The affected of the seed can be a cause of their germination lowering.

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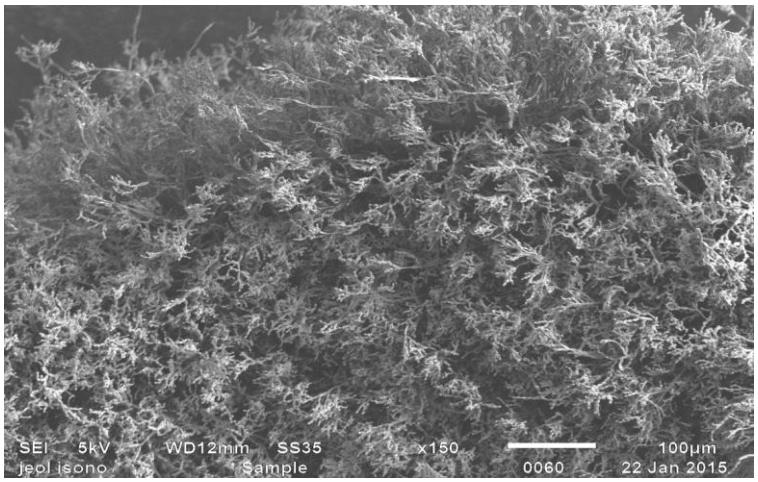
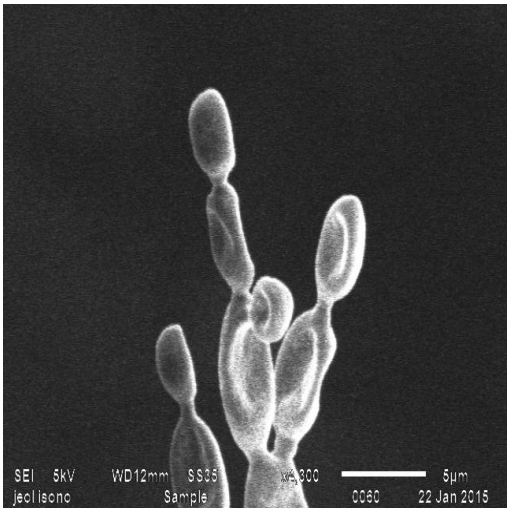
«Trees» trunk is formed by brownish or pale olive conidiophores, usually erect, septated, unbranched or rarely with 1-2 lateral branches. «Crone» consists of short branched chains of conidia, which give the impression of lateral branches. The presence of such side chains indicates that the apex of conidiophores continued to grow after the formation of the first conidia. Long cylindrical conidia depart directly from the conidiophores. They are called basal conidia or metaconid. Metaconid gives rise to the shorter oblong-elliptical or cylindrical conidia, which, in turn, bud single cell conidia ovate, oval or round shape. Thus, in one conidiophore conidia can vary in shape and size. Conidia capsule can be smooth or prickly. Young conidia are always smooth, colourless, and single cell. When they mature in many species the capsule becomes prickly and transverse septum appears. The colour varies from pale olive to brown. Conidia germinate in 5-6 hours with one or two, rarely three sprout tubes. Separate conidienosets has from 100 to 300 conidia depending on environmental factors. Fungi parasitizing on plants have larger conidia and their number on the conidiophore is considerably smaller than in saprophytic species.

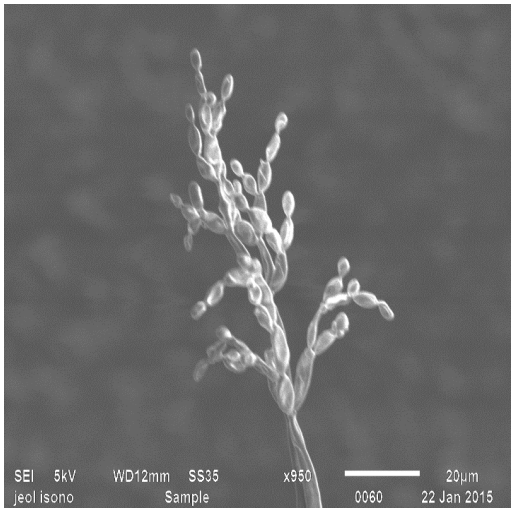
Cladosporium herbarum Fr. mycelium as conidia is brownish-olive. Coating is largely determined by melanin pigment that formed in the cell as a result of enzymatic oxidation of tyrosine or polyphenols. These pigments determine the stability of the mycelium and conidia to the radiation. Therefore, dark-coloured fungi grow well on the surface of plants and other substrates not only in the temperate climate zone, but in deserts and semi-deserts.

Cladosporium herb (C. herbarum) is the most common type, which grows on a wide variety of organic substrates. In pure culture, it grows in the dense velvety colonies with olive, black or greenish colour. Fungus destroys feedstock containing cellulose and pectin, changes colour of the paper and surface layers of the wood.



Picture. 2. Colony of the fungus named Cladosporium herbarum Fr.





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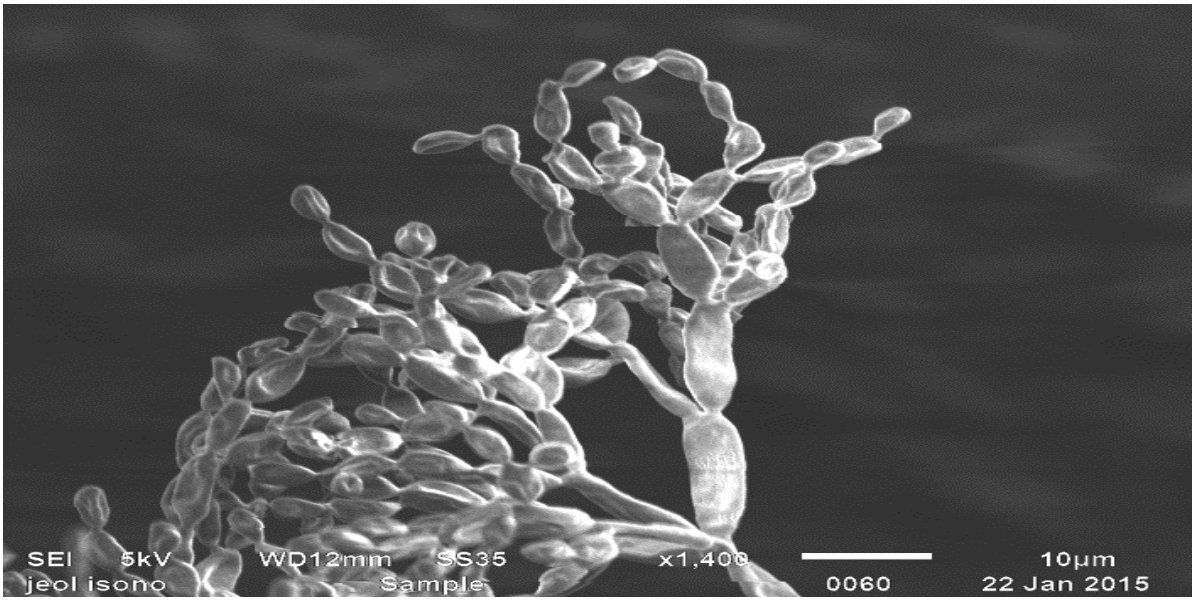
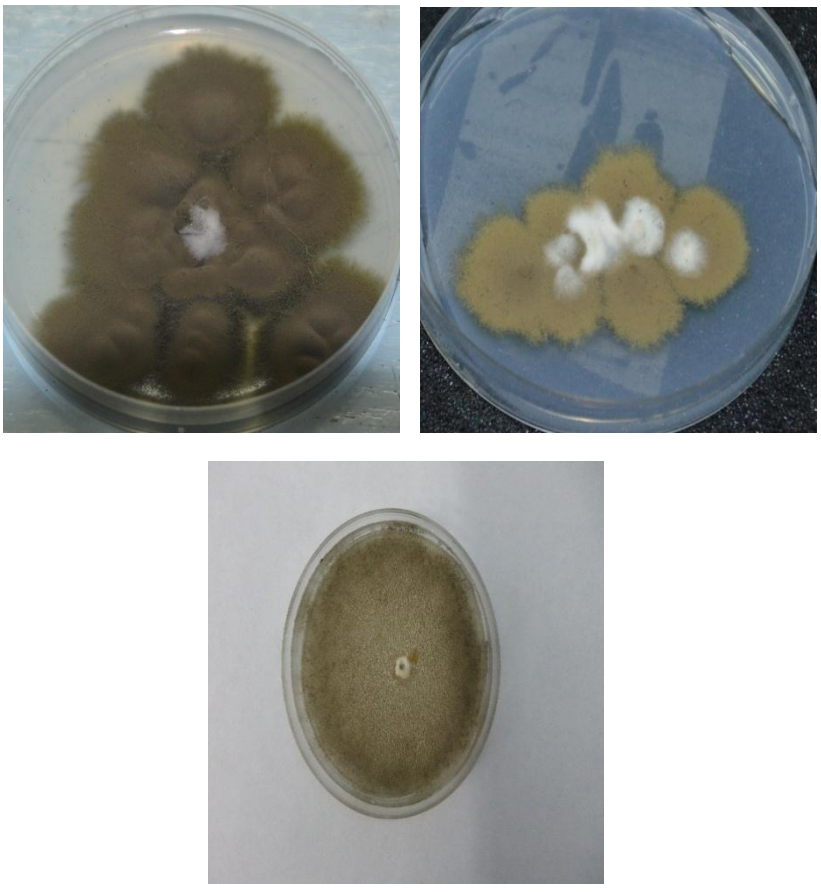


Picture. 3. Conidia and conidiophores of the fungus Cladosporium herbarum Fr. in the scanner microscope. Conidia are typical spores formed by asexual reproduction of Cladosporium herbarum Fr. This electron micrograph presents different stages of the development of the fungus Conidia on Zea mays L.



Picture. 4. Pure culture of Cladosporium herbarum Fr. placed in a Capek nutrient medium. Features of the distribution of Cladosporium herbarum Fr. in nature are shown in Table. 1.

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Table 1. Features of the spread of the fungus Cladosporium herbarum Fr. isolated from Zea mays L. seed

Seedlings test cultures	Description seedlings test cultures	The degree of damage
Triticum aestivum L.	Underground organs of vegetative sprouts	Mycelium with conidia around Inoculum is formed.
	Aerial organs of vegetative sprouts	Conidia inoculum is abundantly formed on yellowed casting and covered with gray mycelium.
	Torn bodies of seedling	Leaves around inoculum's cilia have developed into a more rapid buildup and conidia are abundantly formed. Stalks are covered with gray mycelium with weak damaged seeds, isolated conidia layers are formed. Conidia are not formed and seedlings are damaged.
Hordeum vulgare L.	Underground organs of vegetative sprouts	Inoculum around cilia is built up at a high level; other only section of the veins conidia cilia is formed by damaged cilia.
	Aerial organs of vegetative sprouts	Formation of conidia is seen around leaves' inoculum.
	Torn bodies of seedling	Inoculum's sides became yellow, on leaves conidia formation is seen Seedling white mycelium covered and conidia is formed on inoculum's sides. Mycelium has abundantly covered stalks and inoculum's sides, and conidia on layer have been developed.
Avena sativa L.	Underground organs of vegetative sprouts	Roots at higher level have been damaged, mycelium has been spread on whole part has grown up; cladosporium's mycelium is abundantly grown up on inoculum's sides, conidia very richly is formed.
	Aerial organs of vegetative sprouts	Mycelium has abundantly grown up on leaves; however, conidia are not formed.
	Torn bodies of seedling	Mycelium has abundantly grown up on seedling's inoculum's sides, mycelium covering has entirely grown up on seedling. Mycelium has richly grown up and conidia are present on inoculum's sides, mycelium and conidia are not formed on other parts.
Zea mays L.	Underground organs of vegetative sprouts	Similar to white cotton mycelium covered inoculum's sides, conidia is abundantly formed.
	Aerial organs of vegetative sprouts	Damaged leaves have grown up, cilia which have become yellow have grown up radially, and conidia are abundantly formed.
	Torn bodies of seedling	On seedling whole body covering white mycelium covered, howeverconidia and conidia layeris not formed. Mycelium has covered, on inoculum's sides and conidia are abundantly formed. Inoculum's sides on the leaves have become yellow and conidia are abundantly formed.
Oryza sativa L.	Underground organs of vegetative sprouts	Mycelium is formed on roots, however, conidia formation is not seen
	Aerial organs of vegetative sprouts	Conidia formation is seen inoculum's sides and on the leaves

	Torn bodies of seedling	Stalk is damaged, and leaves'whole part got yellow, mycelium on leaves has abundantly grown up and conidia are abundantly formed. Seedling at higher level being damaged has blackened, mycelium's seedling's outer side has slightly grown up, and small portion of conidia has been developed. Inoculum's sides became yellow, however conidia formation is seen just on leaves
Panicum miliaceum L.	Underground organs of vegetative sprouts	On inoculum's sides mycelium has grown up, conidia is formed.
	Aerial organs of vegetative sprouts	Conidia abundantly formation is seen around inoculum and on leaves which have become yellow
	Torn bodies of seedling	Its leaves and inoculum's sides have become yellow and conidia are abundantly formed. Stalk has been changed on seedling and mycelium has grown up on inoculum's sides and slight conidia are formed, however stalk has been changed, but seedling is not damaged.
Sorghum vulgare L.	Underground organs of vegetative sprouts	Slight conidia is formed
	Aerial organs of vegetative sprouts	Leaf has become yellow and around inoculum conidia abundantly formation is seen
	Torn bodies of seedling	Inoculum's sides have become yellow and conidia are abundantly formed
Solanum melongena L.	Underground organs of vegetative sprouts	Conidia formation is seen
	Aerial organs of vegetative sprouts	On leaves which have become yellow conidia formation is seen
	Torn bodies of seedling	Conidia formation just on leaves is seen
Raphanus sativus L.	Underground organs of vegetative sprouts	Damage has been developed
	Aerial organs of vegetative sprouts	On leaves conidia formation is seen
	Torn bodies of seedling	Inoculum around conidia formation is seen
Lycopersicon esculentum L.	Underground organs of vegetative sprouts	Damage is seen
	Aerial organs of vegetative sprouts	Leaf has become yellow and conidia formation is seen on inoculum's sides
	Torn bodies of seedling	Inoculum's sides have become yellow and conidia are abundantly formed
Solanum tuberosum L.	Underground organs of vegetative sprouts	On roots conidia formation is seen
	Aerial organs of vegetative sprouts	Leaf has become yellow and conidia formation is seen on inoculum's sides
	Torn bodies of seedling	Inoculum's sides have become yellow conidia abundantly formed
Daucus carota L.	Underground organs of vegetative sprouts	Damage has been developed
	Aerial organs of vegetative sprouts	Leaf has become yellow and conidia formation is seen on inoculum's sides
	Torn bodies of seedling	Besides seedling inoculum's sides have become yellow and conidia are

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		abundantly formed on other parts
Allium cepa L.	Underground organs of vegetative sprouts	Damage is not seen
	Aerial organs of vegetative sprouts	Conidia formation is seen
	Torn bodies of seedling	Conidia formation is not seen
Cucumis sativus L.	Underground organs of vegetative sprouts	Damage has developed
	Aerial organs of vegetative sprouts	Conidia formation is seen around inoculum
	Torn bodies of seedling	Besides seedling on other parts inoculum's sides have become yellow and conidia have been abundantly formed.

As it is stated above, Cladosporium herbarum Fr. affects meat products also. Experimentalists decided to check it, and by the method of N.I. Wasilewski (1984) they infected with the inoculum the beef and its fat. Experiment showed that the fungus strong affected meat and fat on the average. Conidial is abundantly formed in the substrate.

Picture. 5. Artificial contamination of the grain and melons by N.I. Wasilewski (1950).

Highest parasitic property of the Cladosporium herbarum Fr. has been seen as the result of its contamination by the method of N.I. Wasilewski (1950). Among the 14 cultures (7 grain seedlings, 7 vegetable and technical seedlings) Allium sulfur had resistance to the contamination, and other cultures had signs of the contamination. Zea mays L., Cucumis sativus L., Daucus carota L., Solanum tuberosum L., Lycopersicon esculentum L., Raphanus sativus L., Sorghum vulgare L. Triticum aestivum L., Avena sativa L., Hordeum vulgare L., Panicum miliaceum were strong infected and only Oryza sativa L. underground parts were not infected.

CONCLUSIONS

The most numerous and widely represented in this way saprophytic species are olive-green mildews. They are often found on dying on the vine plants and all kinds of plant remains, in some cases playing a positive role, in the other - negative. Cladosporium herb (C. herbarum) and other saprophytic species often develop (especially after wet seasons) on the weevil of the cereal grains and cause grain blackening and hitting in the vault – its damage. If the grains stay winter under the snow (such as wheat, rye, and millet), the mycelium of Cladosporium penetrates the grain and makes it toxic to humans and animals. Many fungi appear first on decaying plants, and then can cause hay spoilage in the storage even in slightly elevated humidity conditions.

In the study Cladosporium herbarum Fr.'s showed its highest parasitic features.

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