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FEATURES OF FUMONISIN TOXINS BIOACCUMULATION ON WINTER WHEAT IN THE CONDITIONS OF UKRAINIAN AGROCENOSIS

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Humans and animals diseases caused by Fusarium's toxins have become a world problem in recent years. According to FAO (Food and Agriculture Organization), today, 25 % of produced grains are infected with toxic fungi. Fusarium's infected cereals are the dangerous poisons for human and animal organisms in case of their usage as foods or feeds.

Ukraine is a powerful agro-industrial country, in which level of cereals yield has great impact on economic and social spheres. So, studying fungi toxins bioaccumulation helps to develop methods for infection prevention.

Key words: *Fusarium spp., fungi, mycotoxins, fumonisins, winter wheat, bioaccumulation.*

Introduction. Some *Fusarium* species like *Fusarium verticillioides* (or *F. moniliforme*), *F. proliferatum*, *F. graminearum*, or *F. culmorum* cause disease of cereals called 'head blight' or fusariosis. These pathogens are widespread in both temperate and subtropical areas, including Ukrainian cereals growing areas. Crops which can be infected are wheat, barley, triticale, oats, rye, maize with reduction in yield often in range from 10 to 30 % [1].

Inspection of literature reviews resulted that the problem of mycotoxins spreading in the crop yield and efficient treating of it are actual questions nowadays. Successful struggle with toxins accumulation and prevention of their negative effect should be started from the understanding of mycotoxins' bioaccumulation principles, mechanisms of their action and studying of their producers' nature.

The most poorly studied mycotoxins which infect cereals are fumonisins [2].

Fumonisins. *Fusarium* spp. produce a great variety of secondary metabolites with poison nature called mycotoxins. The most dangerous are two big groups called fumonisins and trichothecenes. The great impact on yield cause trichothecenes mycotoxins, especially for wheat, barley or triticale yield, but another group, named fumonisins, can crucially affect on the maize and wheat crops.

The fumonisins are a group of mycotoxins derived from *Fusarium* spp. They were firstly marked in 1988. Today, there are 28 knew analogues which are divided into 4 groups: A, B, C, D, the most toxic is a group B [3]. They have strong structural similarity to sphinganine, the backbone precursor of sphingolipids. This fact explains toxicity of fumonisins. This similarity has been shown to disturb the metabolism of sphingolipids by inhibiting the enzyme ceramide synthase leading to accumulation of sphinganine in cells and tissues [4].

The references analysis on the toxicity of fumonisins were justified and approved national maximum permitted levels of this mycotoxin in feed equal 0.005 µg/kg [2].

***Fusarium* spp. as producers of fumonisins.** Fumonisins are mycotoxins often produced by the fungus *F. verticillioides* (or *F. moniliforme*) and *F. proliferatum*, which commonly infects corn, wheat and other agricultural products. Most *Fusarium* species isolated from substrates in nature produce macronidia on sporodochia and are called sporodochial types [5]. The macroconidia of *F. moniliforme* are sickle-shaped to straight with the dorsal and ventral surfaces almost parallel [6]. The microconidia are primarily single-celled and are ovoid to obovoid in shape with a truncate base [5].

Features of crops infection by *Fusarium* fungi. The typical symptom of wheat infection by the fungus *F. graminearum* is clearly visible with naked eye pink taint on the ear. The same taint on glumes is formed in case of infection by *F. verticillioides*. However, most species of *Fusarium* fungi do not cause visible changes of grain and typical symptoms on spikelets [8].

The most common ear infection by *Fusarium* is it infection during flowering through protruding anthers. Later, first symptoms appear in the form of watery brown

spots at the down part of spikelet glumes. Early ripening of ears is a characteristic feature which is determined by presence of white color on the white on a green background of unripe ears. Also, infection can penetrate the ear with drops of rain or dew after peak bloom. In this case, another type of infection will develop, which leads to the accumulation of mycotoxins, but without visible symptoms in the ear and grain. This includes the most common pathogen – *F. graminearum*. Other pathogens may develop and infect plants throughout the growing season, causing except *Fusarium* ear and other diseases such as snow mold, *Fusarium* root rot etc. [7].

Conditions for mycotoxins production and accumulation in Ukraine. Scientific works carried out in Ukraine and Europe show that there is a clear tendency to reduce the number of pathogenic species that cause mycotoxins producing. The frequency of typical pathogens such as *F. graminearum* and *F. verticillioides* isolation gradually reduced, and fungi that can grow in dry weather conditions begin to dominate. The danger of these agents that it is difficult to render them in grain formation.

It is proved that the weather conditions, including moisturizing regime influence on the formation of species composition and varieties ratio. Rain that fell during flowering and ripening of crops played the main role – they determine the level of development and the spread of disease [10].

Analysis of scientific works [8, 11–13] gives a result of features of mycotoxins accumulation. Table 1 represents optimal conditions for fumonisins production by *Fusarium* spp.

Table 1

Conditions for fumonisins production and accumulation by *Fusarium* spp.

Criteria	*F. graminearum*	*F. verticillioides*
Temperature of growing, ºC	15–30	15–25
Optimal temperature for mycotoxins production, ºC	24–26	22–24
pH	6.7–7.2	3.0–9.5
Relative humidity, %	≥ 85	90–95
Grain humidity, %	45–50	28–31

CONCLUSION

Wheat is associated with many fungi, as causal agents of harmful diseases or secondary invaders. Pathogenic micromycetes cause the destruction of the host tissue and poisoned mycotoxins accumulation. That's why yield of crops become less qualitative and agricultural sphere of Ukrainian economy suffer from lack of wheat of high quality.

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ОСОБЛИВОСТІ БІОАКУМУЛЯЦІЇ ТОКСИНІВ ФУМОНІЗИНІВ НА ОЗИМІЙ ПШЕНИЦІ В УМОВАХ АГРОЦЕНОЗУ УКРАЇНИ

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Хвороби людей та тварин, спричинені токсинами, що продукуються грибами роду Fusarium, стали на сьогоднішній день світовою проблемою. Згідно із Продовольчою та сільськогосподарською організацією, 25 % врожаїв зерна інфіковані токсичними грибами. Для людей та тварин такы злакові є отруйними та небезпечними, якщо їх використовувати як продукти харчування.

Україна – це потужна агропромислова держава, у якій врожай зернових впливає на економічну та соціальну сфери. Тому вивчення біоакумуляції токсинів допоможе розробити методи запобігання інфікуванню.

Ключові слова: *Fusarium, одноклітинні гриби, мікотоксини, фумонізіни, озима пшениця, біоакумуляція.*

ОСОБЕННОСТИ БИОАККУМУЛЯЦИИ ТОКСИНОВ ФУМОНИЗИНОВ НА ОЗИМОЙ ПШЕНИЦЕ В УСЛОВИЯХ АГРОЦЕНОЗА УКРАИНЫ

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Болезни людей и животных, вызванные токсинами, что вырабатываются грибами рода Fusarium, стали на сегодня мировой проблемой. Согласно Продовольственной и сельскохозяйственной организации, 25 % урожая зерна заражены токсичными грибами. Для людей и животных такие зерновые ядовиты и небезопасны, в случае их потребления в качестве пищи и кормов.

Украина – это мощная агропромышленная страна, в которой урожай злаковых влияет на экономическую и социальную сферы жизни. Поэтому изучение биоаккумуляции токсинов поможет разработать методы препятствия заражению.

Ключевые слова: *Fusarium, одноклеточные грибы, микотоксины, фумонизины, озимая пшеница, биоаккумуляция.*