АГРОХИМИЯ, АГРОПОЧВОВЕДЕНИЕ, ЗАЩИТА И КАРАНТИН РАСТЕНИЙ / AGROCHEMISTRY, AGROSOIL SCIENCE, PLANT PROTECTION AND QUARANTINE

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RESULTS OF THE PHYTOSANITARY MONITORING OF CORN FUNGAL DISEASES

Research article

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Abstract

Corn is one of the most popular grain crops in the world. However, there is a serious limiting factor for its cultivation, i.e. the evidently high susceptibility of *Zea mays* to diseases. The paper presents the results of the phytosanitary monitoring of the main fungal pathogens in cornfields under the conditions of Primorsky kray. Northern corn leaf blight (*Helminthosporium turcicum*) and Fusarium ear rot (*Fusarium moniliforme* S.) are among the most widespread fungal diseases. The research revealed that the prevalence of *Helminthosporium turcicum* varied from 20 to 100% depending on the zone and that of Fusarium ear rote – from 9 to 52%, the prevalence of head and common smut did not exceed 3 and 0.6%, respectively.

Keywords: maize, diseases, northern corn leaf blight, smut, Fusarium ear rot, prevalence.

РЕЗУЛЬТАТЫ ФИТОСАНИТАРНОГО МОНИТОРИНГА ГРИБНЫХ БОЛЕЗНЕЙ КУКУРУЗЫ

Научная статья

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Аннотация

Одной из самых распространённых зерновых культур в мире является кукуруза. Однако одним из лимитирующих факторов возделывания *Zea mays* является заметное поражение посевов этой культуры болезнями. В статье приведены результаты по фитосанитарному мониторингу основных грибных патогенов кукурузы в условиях Приморского края. Среди грибных болезней наибольшее распространение имеют такие болезни как северный гельминтоспориоз (*Helminthosporium turcicum*) и фузариоз початков (*Fusarium moniliforme* S.) В результате исследований выявлено, что распространённость *Helminthosporium turcicum* в зависимости от зоны варьировала от 20 до 100%, фузариоза початков – от 9 до 52%, пыльной головни не превышала 3%, а пузырчатой – 0,6%.

Ключевые слова: кукуруза, болезни, гельминтоспориоз, головня, фузариоз, распространённость.

Introduction

Corn is one of the most widespread crops (*Zea mays*), which is valued for its high potential yield and versatility all around the world [1]. *Zea mays* is used for the production of food and animal feed [2] and as crude material in industry. Corn grain is rich in oil, starch, protein, and energy [3].

However, there are numerous diseases that cause considerable damage to cornfields. The yield loss often exceeds 50% and the grain quality decreases drastically [4].

More than 400 corn diseases are known, many of which can damage plants during not only the growing period but also storage. The following pathogens are the most common: *Helminthosporium turcicum*, *Ustilago maydis*, *Fusarium moniliforme* S., *Bipolaris maydis*, *Bipolaris sorokiniana,* and *Bipolaris zeicola* – they damage leaves, stalks, and ears of corn plants [5], [6].

Fungi from the genus *Helminthosporium* take a special place among the fungal pathogens of agricultural crops. The research on corn leaf blights began in Italy [7] and the USA in the second half of the 19th century, when *Helminthosporium turcicum* (the causative agent of the northern corn leaf blight) was described for the first time [8]. It is considered the most common and harmful of all corn leaf blights in the world.

In our country, the northern corn leaf blight was first reported in Sochi city district in 1914 [9]. Later this pathogen was found in Abkhazia and by 1940 *Helminthosporium turcicum* spread everywhere. When the disease is advanced, damaged leaves wither prematurely and the nutritive value of the feed decreases. Moreover, the yield of grain and herbage may drop by 80-85 % [10].

Common (Ustilago maydis) and head (Sphacelotheca reiliana) smuts have been viewed as the most harmful corn diseases in Russia for a long time. Corn plants are susceptible to this pathogen during the entire growing period. The disease progression is characterized by the formation of blisters varying in size and whitish nodules. On average, Ustilago maydis

damages 3-6% of Zea mays plants in Krasnodarsky kray annually (10-12 % in some years), and the loss of productivity might reach 25-30% [11]. It was established that outbreaks of the disease occur in the conditions of Primorsky Krai at the tasseling stage and cause the most damage to extremely early, early, and mid-early forms. According to the research results obtained by A.K. Chaiki and T.D. Martynyuk in the 1990s, the prevalence of the common smut ranged from 1.0 to 17.0% in Primorsky Krai, and that of head smut – from 1.0 to 25% [12]. These diseases cause significant damage overseas as well, where the highest yield loss may be up to 68% [13].

Sphacelotheca reiliana is no less harmful. Head smut is widespread in Europe, Africa, North America. Australia, and Asia [14]. The yield loss may amount to 15-20% in the conditions of the Russian South if the development of the pathogen is severe [15]. However, the disease is rare in the Russian Far East [16].

The most common disease of corn ears is Fusarium ear rot (*Fusarium moniliforme* S.), the harmfulness of which depends largely on the timing of initial infection [5].

Zea mays is one of the main fodder crops in the south of the Russian Far East. Today, the achieved level of corn grain and silage production does not meet the existing demand of the increasingly growing animal husbandry for concentrates and succulent feeds. One of the limiting factors is the evidently high susceptibility of corn to diseases.

Research methods and principles

The research examined cornfields (2,400 ha) for fungal pathogens in three eco-climatic zones of Primorsky Krai in 2023.

The methodology of G.V. Grisenko and E.L. Dudka was used to conduct the study on the main fungal diseases [17].

Plants were examined for northern corn leaf blight on a 5-point scale at the milk stage, for Fusarium ear rot on a 5-point scale at the dough stage, and for common smut on a 6-point scale at the dough stage.

The prevalence of each disease was calculated by the following formula (1):

$$P = (n * 100)/N \quad (1)$$

where P – prevalence of a disease (%), n – number of damaged plants, N – total number of the studied plants.

The progression of each disease was calculated by the following formula (2):

$$R = \left(\Sigma\,(a^{*}b)^{*}\,100\right)/(N^{*}K) \quad (2)$$

where R – progression of a disease (%), Σ (a * b) – sum of the products of the diseased plant number (a) and the corresponding damage score (b), N – total number of the studied plants, K – the highest score on the rating scale.

Main results

According to the data of the phytosanitary monitoring, the most widespread leaf disease in 2023 was northern corn leaf blight (Figure 1). The causative agent of the disease is the fungus species *Helminthosporium turcicum* Pass. The first symptoms are greyish green spots varying in shape and appearing on the lowest leaves before the flowering begins. The spots grow with time up to 20-25 cm in length and 5 cm in width, the damaged areas are straw-colored. Our research data showed that the disease prevalence varied depending on the eco-climatic zone: from 20% in the forest-steppe zone to 100 % in the steppe zone (the degree of progression was 1.9-57%).

The most well-known corn ear diseases are Fusarium ear rot, and head and common smuts. The basidiomycete *Ustilago zea* Unger is the causative agent of common smut. Corn plants are susceptible to this pathogen during the entire growing period. *Ustilago maydis* manifests itself on all parts of plants as round blisters differing in size. When they mature the membranes rapture releasing the dark brownish dust-like mass of fungal spores. The highest prevalence of common smut in Primorsky kray was observed in the steppe zone (0.4-0.6%).

Head smut was detected in cornfields in insignificant quantity. The causative agent of the disease is the basidiomycete *Sorosporium reilianum* Mc. Alpine. Unlike common smut, this pathogen damages only corn ears and tassels, which can turn into the dark mass of spores when the disease is advanced. The highest disease progression was observed in the forest steppe and steppe zones, the prevalence was 1.9 and 2.6%, respectively.

The most widespread disease of corn is Fusarium ear rot. The causative agent is the fungal species *Fusarium moniliforte* Sheld., which develops even during harvest and storage. The disease manifests as white and pinkish mold on grains. At the advanced stages, the mold can cover an ear entirely. The phytosanitary monitoring showed that the highest prevalence of Fusarium ear rot was observed in the southern taiga zone (52%) and the lowest prevalence – in the steppe zone (9%). The disease progression ranged from 0.17 to 27.5%.

Figure 1 - Northern corn leaf blight zea mais
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Conclusion

Thus, the year of 2023 had favorable conditions (abundant precipitation and high temperatures in August) for the development of such corn diseases as northern corn leaf blight and Fusarium ear rot. The prevalence of northern corn leaf blight varied from 20 to 100% depending on the eco-climatic zone, and the prevalence of Fusarium ear rot ranged from 9 to 52%. The prevalence of head and common smuts did not exceed 3 and 0.6%, respectively.

Конфликт интересов

Не указан.

Рецензия

Все статьи проходят рецензирование. Но рецензент или автор статьи предпочли не публиковать рецензию к этой статье в открытом доступе. Рецензия может быть предоставлена компетентным органам по запросу.

Conflict of Interest

None declared.

Review

All articles are peer-reviewed. But the reviewer or the author of the article chose not to publish a review of this article in the public domain. The review can be provided to the competent authorities upon request.

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