

## DISEASES OF CORN IN THE BLACK SEA STEPPE OF UKRAINE

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### Abstract

An analysis of the phytosanitary condition of corn grown on the Black Sea steppe of Ukraine was performed. The species composition of the Pathogenic fungal community has been determined and specified. The degree of spread and development of diseases of 3 maize hybrids, different in their biological characteristics, was determined: "Flagman", "Odessa 346 MV", "Kremen 200 SV". Field and laboratory studies have been conducted, the factors contributing to the development of diseases have been analyzed.

**Key words:** pathogens, microflora, corn, diseases.

### Introduction

Ukraine is a European agricultural country with fertile soils and a favorable climate for growing large crops. The modern agro-industrial complex of Ukraine needs to rationally use natural land resources, fertilizers and plant protection products, taking into account the peculiarities of the cultivated crops and the correct composition of the crop rotations, introduction in the production of modern technologies for growing highly productive varieties and hybrids, to provide the population with high quality food.

The main food products are traditionally grain crops, among which special attention is paid to corn. Corn is one of the most important agricultural crops in the world, it is the most productive grain crop with a wide universal purpose, grown for food, fodder and for technical purposes. For Ukraine, corn is an extremely important crop from the point of view of animal husbandry, it provides the industry with a variety of feed, concentrates and silage with green mass. In Ukraine, the area for sowing maize occupies about 5.0 million hectares for green fodder and about 17.0 million hectares of arable land for silage (Kutsenko et al., 2015).

Corn is characterized by great biological potential, which is realized through the use of intensive cultivation technologies. To get a good harvest of high quality, corn must constantly fight pests that have a negative impact on the plant in general and on the quality of the crop in particular.

### *Diseases of corn*

A major role in the cultivation of corn is played by diseases, which are around 50. The most harmful among them are *Fusarium* diseases (pathogens of the genus *Fusarium Link*), which develop in the germination phase, on adult plants, can damage the root system, stem, cobs. *Fusarium* wilt is dangerous primarily from mycotoxins, which release the causative agents of this disease (Balan, 2021). *Fusarium* wilt reduces yields, and signs of grain contamination in the batch significantly reduce the cost of agricultural production. Poor quality feed causes problems in animal nutrition, and the use of foods contaminated with mycotoxins is very dangerous to human health and can lead to death (Balan, 2020).

No less dangerous are head diseases. *Bubblehead* fever is one of the most harmful diseases that develops in the cultivation of corn (caused by the fungus *Ustilago zaeae Unger*). The harmful effect of the ash head is of great negative importance (the cause is the fungus

*Sorosporium reilianum* Mc Apl.f.). Head vesicles most often have an external manifestation on the young leaves and cobs. In some cases, they develop on the aerial roots, which are located on the stems. The affected buds from the rudiments of leaves and stems change into head growths and actively grow, many times exceeding their original appearance (Balan, 2021). Other lesser known but no less dangerous diseases are also found in corn. *Cephalosporosis* (*Cephalosporium acremonium* Cda) – a vascular infection of maize that spreads to the seeds, has a latent development for some time, and then dries the plant during periods of lack of moisture. *Diplodiasis* (*Diplodia zeae* Lev.) – is a common disease of corn, which is called dry rot of corn.

The pathogen secretes neurotoxins that affect the nervous system of animals, they lose appetite, become lethargic and slowly gain weight. *Sclerosporosis* (*Sclerospora maydis* Butler or white-yellow stripe) may cause insufficient yield of green mass and seeds up to 10%. Excessive moisture and high temperatures, especially late sowing of corn, develop brown spot or Helminthosporiosis (*Dlechlsera turcica*).

### **Stem and root rot**

Stem and root rot are very common: *Fusarium* rot (fungi of the genus *Fusarium*), coal rot (*Sclerotium bataticola* Taub.), white rot (*Whetzelinia sclerotinia*), bacterial stem rot (bacteria *Pseudomonas holci* Kendra, *Erwinia carotovora* pv. *Carotovora* Bergey et al. u *Erwinia dissolvens* Beorkh). Maize crops, especially during the second half of the growing season, are found diseases characterized by rot of stems and roots.

### **Diseases of the cobs and seeds**

During ripening and storage, diseases spread on the cobs and seeds: *Fusarium* (*Fusarium Link*), nigrosporosis (*Nigrospora oryzae* Petch), red rot (*Fusarium graminearum* Schwabe), gray rot (*Rhizopus maydis*), bacteriosis of the cobs (*Bacillus merenter*), molds on the cobs and grains (*gray-green mold, dark mold, pink mold*). There are no immune varieties and hybrids of corn for mold. Early-maturing hybrids and varieties, as well as those with yellow or light yellow grains, are less affected in the field.

### **Bacterial and viral diseases**

In addition to the listed bacterial diseases – bacterial rot of the stem and bacteriosis of the cobs, the famous bacterial spot (*Pseudomonas syringae* pv. *Syringae* Young et al), leaf bacterial spots (*Corynebacterium michiganse* pv. *Nedraskense* Young et al) and bacterial wilt of corn (*Erwinia maize stewartii* (Smith) Dye (*Aplanobacter stewartii* Mc. Cull). The latter disease is subject to quarantine for Ukraine. Eight viral diseases of maize have been reported, most of which are common in tropical and subtropical regions. In Ukraine, there are only three viral diseases of corn – pupa (*Siberian oats mosaic virus*), striped (*Maize streak virus*) and dwarf mosaic (*Maize dwarf mosaic virus in Sorghum red stripe virus*) (Balan et al., 2020).

### **Purpose, conditions and methodology of the research**

The main goal of the scientific work is to analyze the phytosanitary condition of the grown corn. The studies were conducted under the conditions of agriculture "Velchu" (Kubey village, Odessa region, Ukraine) in 2019-2020. The experimental fields are located in the typical conditions of the Black Sea steppe on a flat relief and the southern chernozems. This area is characterized by deep groundwater, which cannot be used by maize plants. Determining the species composition, spread and development of diseases, great



importance is attached to the meteorological conditions observed during the growing season. The climate of the region is characterized by extremely dry summers. According to long-term data of the agrometeorological station Odessa, the average annual air temperature is +9.6 °C, with a maximum temperature of 30 °C for 24 days a year. The sum of temperatures above 100 °C reaches 3200-3400 degrees. The amount of precipitation per year is on average about 350-390 mm, and for the period with temperatures above 100 °C – 230-245 mm. The annual relative humidity is 62%. The hydrothermal coefficient (HC) is 0.7-0.8.

Research has been conducted in the field and in the laboratory. The degree of spread and development of pathogens is determined, the factors contributing to the development of diseases are analyzed. The object of the study are the causes of infectious diseases on 3 hybrids of corn, different in their biological characteristics: "Flagman", "Odessa 346 MV", "Kremen 200 SV". In order to detect corn diseases in a timely manner, a systematic field route study of technical crops in the optimal growing season was conducted: 2-3 leaves, the phase of full maturity, overripe stems. The analysis of plant disease damage was performed visually. The spread and development of diseases are reported. To identify pathogens, phytopathological studies of the affected parts of the plant were performed, external examination and microscopy were used. The plant material was further studied by a biological method. Diagnosis of pathogenic microflora is made during the formation of sporulation. The work uses generally accepted methods of field and laboratory research (Grisenko & Dudka, 1980; Popkova, & Shmigli. 1987; Chumakov, 1974).

The diagnosis of maize diseases was made according to the characteristic external signs of manifestation, which were confirmed as a result of laboratory phytopathological examination. Bubble spots are defined in the field in the presence of balloon-like formations of various shapes and sizes on the affected leaves and stems, internodes, leaf base, on cobs, panicles and aerial roots. The ash head is diagnosed with the defeat of the cobs and panicles. They were completely destroyed and turned into black spores, they were sprayed when touched, and the fork turned into a knot.

The *Fusarium* on the cobs is fixed in the form of a white-pink color, which eventually completely destroys the cob, and the grains turn brown and are destroyed. *Fusarium* wilt of the stem was determined on the stems in the form of browning, change in color of the stem to light green, breakage and lodging of the affected plants and by a characteristic pink color. Stem charcoal rot has been identified on the stems in the form of browning and discoloration of the lower stem and root, black sclerotia formed under the epidermis in the form of dots, the parenchyma of the core is destroyed, the stem is dried, some of the plants are lying down.

The root rot of the *Fusarium* was determined by the browning of the sprouts and the root, the death or underdevelopment of the root system, the blackening of the roots, the slowing down of the growth, the leaves wither, some plants die.

The monitoring of the phytosanitary condition of the maize hybrids "Flagman", "Odessa 346 MB" and "Kremen 200 SV" allowed us to determine the extent of spread and development of the diseases and to identify the most common diseases.

### **Results and discussion**

The field route of maize crops in order to detect signs of plant diseases allowed us to define the following species composition of pathogens shown in Table 1.

The degree of spread and development of the diseases was determined: ash head affected 3.8%-7.9% of the plants with a degree of development of 1 point. Bubbleworm spreads in 9.3%-11.6% of plants at 1 point of development. *Fusarium* head blight was developed on 11.2-12.6% of the plants of hybrids "Odessa 346 MB" and "Kremen 200 SV" with development up to 2 points. The "Flagman" hybrid was less affected by cob fusariosis,

up to 4.6% of the plants at 1 point development. Stem rot (coal rot) spreads to 5.8% of the plants of the hybrid “Odessa 346 MB” and 8.1% of the plants of the hybrid “Kremen 200 SV” with the development of 1 point. Stem rot (*Fusarium* rot) of the “Flagman” hybrid spreads to 8.4% of plants with development up to 1 point. Root rot (*Fusarium* rot) was registered in hybrids “Odessa 346 MV” with 8.6% and “Kremen 200 SV” with 13.8% with development up to 1 point. Diseases such as cob bacteriosis and viral mosaic have not been identified by visual signs.

For the development of infectious diseases of corn is strongly influenced by meteorological conditions of the Black Sea steppes of Ukraine during the growing season, is characterized by sharp temperature changes of 15 °C to 45 °C, against the background of significant deficiency and precipitation, which does not contribute to development mass of corn infectious diseases.

**Table 1.** Types of composition of corn disease in the Odessa region in 2019-2020

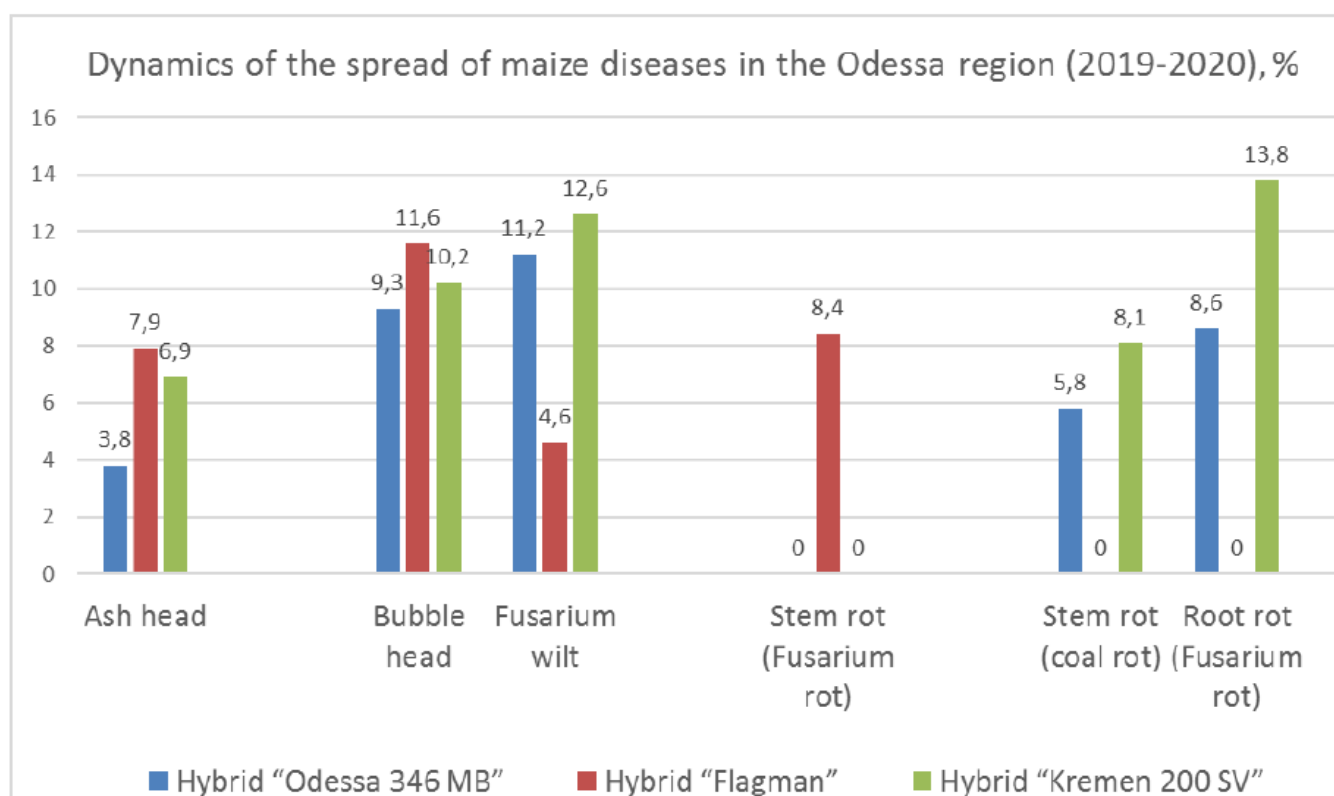
Name of disease	Cause	Signs of damage (symptoms of the disease)	Source of infection
Bubble head	<i>Ustilago zeaе</i>	The bubbles form swellings of different shapes and sizes relative to the leaves, stems, internodes, leaf sheaths, cobs, panicles and on the aerial roots.	Teliospores in bubbles in the soil, on the seeds.
Ash head	<i>Sorosporium reilianum</i> McAplf	The cobs and panicles are completely destroyed and are turned into a black mass of teliospores, which are scattered when touched, a knot is formed in the place of the cob.	Contaminated soil from spores and seeds.
<i>Fusarium</i> on head	A fungus of the genus <i>Fusarium</i>	The cobs form a white-pink color, over time it completely destroys the cobs, karyopsis, turns brown and collapses.	Infected seeds and sclerotia on plant debris.
Stem rot ( <i>Fusarium</i> rot)	A fungus of the genus <i>Fusarium</i>	Stem rot, browning, light green stem, breakage and lodging of the affected plants, pink color is present.	Infected seeds and plant debris.
Stem rot	<i>Sclerotium batotocola</i> Taub.	Causes browning or discoloration of the underside of the stem and root. Beneath the epidermis there are small black sclerotia in the form of dots. The parenchyma of the core is destroyed, the stem dries or disintegrates and breaks easily.	Mycelium sclerotia, plant residues, seeds
Root rot ( <i>Fusarium</i> rot)	A fungus of the genus <i>Fusarium</i>	Darkening of the sprouts and roots, death or underdevelopment of the root system, blackening of the roots, growth retardation, the leaves wither, after which some plants may lie down.	Chlamydospores, mycelium, plant debris, seeds.



As a result of phytosanitary monitoring of 3 maize hybrids in the production conditions of the farm "Velchu" in the Bolgrad region of Odessa region, 6 main diseases of fungal origin were diagnosed:

- 1 disease – root rot (*Fusarium rot*);
- 1 disease – stem rot (*Fusarium rot*);
- 1 disease – stem rot (*Coal rot*);
- 3 diseases – cob damage (*Fusarium head blight*, ash and blister head).

Dynamics of the spread of maize diseases in Odessa region, Ukraine in 2019-2020 is shown in Figure 1.



\*Bacteriosis of the cobs and Viral mosaic by visual signs in the Odessa region in the period 2019-2020 were not identified.

**Figure 1.** Dynamics of the spread of maize diseases in the Odessa region (2019-2020), %

Based on the results of the research we were able to diagnose mainly the causes of fungal diseases of corn, namely ash, which affected 3.8% of the plants of the hybrid "Odessa 346 MB", 7.9% of plants of the hybrid "Flagman" and 6.9% from plants of hybrid "Kremen 200 SV". The degree of development of the disease was within 1 point. Bubblehead was identified on 9.3% of the plants of the hybrid "Odessa 346 MB", on 11.6% of the plants of the hybrid "Flagman" and 10.2% of the plants of the hybrid "Kremen 200 SV" with the development of 1 point. *Fusarium* head grows on 11.2% of the plants of the hybrid "Odessa 346 MB" and 12.6% of the plants of the hybrid "Kremen 200 SV" with development up to 2 points. In the "Flagman" hybrid, 4.6% of the plants are affected by *Fusarium* on the cob with the development of 1 point. Particular attention was paid to stem damage and root rot. In the hybrid "Odessa 346 MB", the stem coal rot spreads to 5.8% of the plants, in the hybrid

“Kremen 200 SV” to 8.1% of the plants. The development is almost identical to 1 point. *Fusarium* head rot of the “Flagman” hybrid spreads to 8.4% of plants with development up to 1 point. The root form of fusarium rot was registered in hybrids “Odessa 346 MV” with 8.6% and “Kremen 200 SV” with 13.8% with development up to 1 point. Diseases such as cob bacteriosis and viral mosaic have not been identified by visual signs.

In general, the agro-climatic conditions of the Black Sea steppe of Ukraine (high temperatures and lack of precipitation) do not contribute to the mass development of diseases, but with periodic increase in humidity against high temperatures, epiphytic foci of pathogens may occur, which is why regular to monitor the phytosanitary condition of the crops, to conduct route field studies with further laboratory phytopathological examination.

### **Conclusion**

1. An analysis of the phytosanitary condition of maize has been carried out, the species composition of the main diseases has been determined and specified. As a result of phytopathological examination of 3 maize hybrids in the production conditions of the farm “Velchu” in the Kubey village, Odessa region, Ukraine 6 main diseases of fungal origin were diagnosed. One - root rot (*Fusarium* rot), one – stem rot (*Fusarium* rot), one – stem rot (coal rot), three – diseases affecting mainly the cob (*Fusarium* head blight, ash and bubble rot).

2. The degree of spread and development of the diseases was determined: ash head affected 3.8%-7.9% of the plants with a degree of development of 1 point. Bubbleworm spreads in 9.3%-11.6% of plants at 1 point of development. *Fusarium* head blight was developed on 11.2-12.6% of the plants of hybrids “Odessa 346 MB” and “Kremen 200 SV” with development up to 2 points. The “Flagman” hybrid was less affected by cob fusariosis, up to 4.6% of the plants at 1 point development. Stem rot (coal rot) spreads to 5.8% of the plants of the hybrid “Odessa 346 MB” and 8.1% of the plants of the hybrid “Kremen 200 SV” with the development of 1 point. Stem rot (*Fusarium* rot) of the “Flagman” hybrid spreads to 8.4% of plants with development up to 1 point. Root rot (*Fusarium* rot) was registered in hybrids “Odessa 346 MV” with 8.6% and “Kremen 200 SV” with 13.8% with development up to 1 point. Diseases such as cob bacteriosis and viral mosaic have not been identified by visual signs.

3. The development of infectious diseases of maize is significantly influenced by the meteorological conditions of the Black Sea steppe of Ukraine during the growing season, characterized by sharp temperature drops from 15 °C to 45 °C against a background of significant rainfall, which did not contribute to the mass development of infectious diseases of maize.

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