PATHOGENIC MICROFLORA OF SUNFLOWER IN THE SOUTHERN STEPPE OF UKRAINE

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Resume

An analysis of the pathogenic microflora of sunflower was performed and was determined by its composition. The degree of spread and development of pathogens on selection samples was determined. Dominant species have been identified. The factors contributing to the development and spread of diseases were analyzed.

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

INTRODUCTION

Among European countries, Ukraine is one of the leaders in terms of fertile soils and crop diversity. Historically, the territory of Ukraine has developed such agro-climatic conditions that allow the cultivation of cereals, legumes, industrial, vegetable and fruit crops. Odessa region is located in the southern steppe zone of Ukraine, in its western part. The climate is characterized by high temperatures and lack of humidity. Under such agro-climatic conditions, sunflower is of great national economic importance, widely used in the food industry, fodder production and technical industry (Nikitchin, 1993). Growing sunflowers is economically justified. Sunflower oil contains vitamins D, B, A, E, K, physiologically active compounds (phosphatides, stearins). Biologically active linoleic acid is indispensable in human nutrition.

In the production of fodder, products obtained from the processing of sunflower are used: sunflower cake and meal, which contain up to 48% protein. Sunflower husk is used to produce pellets for heating, technical alcohol, yeast and furfural for the technical industry. Sunflower contains many nutrients: 1 ton of sunflower flour corresponds to 800-900 kg of oats or 700-800 kg of barley in nutritional terms. In addition, sunflower is an excellent honey plant, from 1 hectare of sunflower you can collect 20-40 kg of honey (Lukomec et al., 2011).

Today in Ukraine are zoned varieties and hybrids of sunflower from local and foreign selection of different groups of maturity and resistance to herbicides. Under favorable agro-climatic conditions and modern cultivation technology, the yield of sunflower can reach 3 t/ha. Often, if crop rotation and agronomic measures are not observed and there is a shortage of funds for mineral fertilizers and preparations for crop treatment against harmful organisms, there is a high probability of spreading dangerous diseases (Balan, 2001; Balan, 2002).

According to their impact on plants, diseases can be divided into 2 groups. The first includes diseases that cause death and decay of sunflower baskets (sclerotinosis), white rot (*Whetzelinia sclerotiorum* (Lib.) Korf & Dumont), gray rot (*Botrytis cinerea* Fr.) or severe oppression colored parasitic broomrape (*Orobanche cumana* Wallr.). Most of these diseases are characterized by a short period of development, as a result of which the

affected plants die quickly. The second group consists of leaf diseases that indirectly affect, do not cause death, but with strong development significantly reduce the yield. This group includes rust (*Puccinia helianthi* Schw.), Leaf spot septoria (*Septoria helianthi* Ell et Keel.), Alternaria (*Alternaria* Nees.), Phomosis (*Phoma helianthi* Aleks.) And false powdery mildew (*Plasmopara helianthi* Novot.f. Nova Helianthi).

Particularly noteworthy is the sunflower phomopsis or the dark heliantia gray spot on the sunflower stems. This disease was subject to internal and external quarantine in Ukraine until 2002. Some questions of the etiology and pathogenesis of this pathogen are still being studied (Balan, 2002). The leaf spots have a long period of growth and as a result of their massive development the leaves dry out prematurely. Verticillium (*Verticillium dahlia* Kleb.) occupies an intermediate position. In connection with the oppression and drying of the plant, the disease can be attributed to the first group, but according to the manifestation of leaf spot disease in the beginning it can be referred to the second group. In addition to fungal diseases of sunflower, there are also bacterial, viral and micro plasma diseases (Petrenkova et al., 2004).

The main goal of this study is to analyze the pathogenic microflora of growing sunflowers and to clarify its species composition. The secondary objective of the study is to determine the extent of spread and development of pathogens on breeding samples and to identify the dominant species.

RESEARCH METHODOLOGY

The object of the study are pathogens of infectious diseases of sunflower of 50 varieties and hybrids of sunflower demonstration variety testing of local and foreign selection of different groups of herbicide resistance from the collection of the Department of Selection of Oilseeds of the Breeding and Genetic Institute of Ukraine.

The study was conducted in the experimental farm "Dachnaya" of the Breeding and Genetic Institute – National Center for Seed Production and Variety Research of the National Academy of Agrarian Sciences of Ukraine (village Dachnaya, Belyaevsky district, Odessa region) in 2018-2019.

The determination of the species composition of the pathogenic microflora was performed on sunflower plants in the filling and ripening phases of the baskets (August). The experimental fields are located in typical conditions for the Southern steppe of the flat relief of the southern chernozems. The counting area of each sample is 10 m^2. The experiments were performed in duplicate. Sowing is done in late April - early May.

Determining the species composition of the pathogenic microflora, the spread and development of diseases, great importance is given to the meteorological conditions observed during the growing season. The distinguishing feature of the summer vegetation period of the plants are the temperature drops from very high (35-45°C) to moderate (15-20°C), and the drought is often replaced by heavy rains. The climatic conditions of the study period were extreme; the average daily air temperature was higher than the average for the region with 3-5°C with moisture deficit.

The analysis of plant damage by diseases was performed visually, according to generally accepted field research methods (Dospekhov, 1979). Plants with signs of damage were labeled on scales, according to each disease from the samples taken. The spread and development of diseases are recorded. To determine the pathogenic microflora, phytopathological studies of the affected parts of the plant (leaves, baskets) were conducted in the Department of Phytopathology and Entomology at the Breeding and Genetics Institute of Ukraine.

External examination and microscopy were used during the phytopathological examination. The analysis of the affected tissues was performed by an anatomical method, using incisions of necrotic tissue and viewed under a binocular microscope. The plant material was further studied by biological method. The diagnosis of pathogenic microflora was made during the formation of sporulations (Bilay, 1982; Sokirko et al., 2014).

RESEARCH RESULTS

The analysis of samples of 50 lines and hybrids of sunflower in demonstration testing of different groups of maturity and resistance to herbicides, 12 pathogens were identified: 11 of fungal origin and tracheobacteriosis (vascular bacteriosis). The diseases were diagnosed by obvious external symptoms specific to a specific disease, which were confirmed by laboratory phytopathological studies. The results are shown in Table 1.

Table 1.

Species composition of the pathogenic mycobiota of sunflower in Odessa region in 2018-2019

Pathogen	Name of the disease	Symptoms of the disease
Botrytis cinerea Pers.	Gray rot	The shape of the basket, there are greasy stains on it with a gray coating, the cap collapses
Sclerotium bataticola Taub.	Ash rot	Brown spots on the stems, the parenchyma is destroyed, the plants wither
Plasmopara helianthi Novot.	Fake powdery mildew	Growth retardation. Light green spots on the leaves, light gray color of the spores on the underside of the leaves
Erysiphe cichoracearum DC. f. Helian	Powdery mildew	Powdery color on the leaves, over time it turns brown, the leaves are fragile
Puccinia helianthi Schw.	Rust	On the leaves below small, powdery orange-brown pustules
Phoma helianthi Aleks.	Phomosis	The leaves have brown spots, over time it spreads to the stalk and root of the stem (similar to phomopsis)
Phomopsis helianthi Munt.-Cwet.	Phomopsis	On the leaves the brown spots pass to the stalk and the stem along the veins with a triangular shape
Septoria helianthi Ell et Keel.	Septoria	The leaves have round yellow spots with a bright cover, which darken over time
Ascohyta helianthi Abramow.	Ascochitosis	Dark brown spots on leaves and stems
Alternaria Nees.	Alternaria	Necrotic spots with olive color on the leaves and stems
Verticillium dahliae Kleb.	Vertical wilting	Systemic vascular damage, wilting, yellowing and drying of the leaves
Bacteria of the genus *Pseudomonas*	Bacterial wilt	Oily spots on the leaves, the leaves wither and dry out. Black stripes on the stems and stalks

Table 1 shows that 12 pathogens were identified in sunflower samples – 11 of which were of mycological origin. Pathogenic microorganisms form a typical spore formation, which further determines their systematic position. There are 2 types of rot – gray (basket shape) and ash rot (stem shape). True and false powdery mildew have been diagnosed. Leaf spots have been identified: alternaria, ascochitis, septoria, phomosis, and phoma. They have their own characteristic shape and color of the spots. Rust is clearly visible on the leaves in the form of protruding orange pustules. Verticiliasis developed very actively, in the form of spots on the leaves, turning into wilting all over the plant. In isolated cases, the bacteriosis manifests itself in the form of black stripes on the stem and oily spots.

The analysis of the phytosanitary condition of sunflower allowed us, in addition to the species composition of pathogens, to determine the degree of their distribution and development, to identify the dominant species, the results of which are presented in Table 2.

Table 2.

Distribution and development of sunflower pathogens in Odessa region in 2018-2019

Pathogen	**Name of the disease**	**Development indicators**		
		Distribution, %	**Pathogen development, %**	**Level**
Sclerotium bataticola Taub.	Ash rot	0,5	0,01	Min
Botrytis cinerea Pers.	Gray rot	2,0	1,0	Min
Bacteria of the genus *Pseudomonas*	Bacterial wilt	10,0	0,5	Min
Phomopsis helianthi Munt.-Cwet.	Phomopsis	15,0	7,0	Average
Septoria helianthi Ell. et Keel.	Septoria	16,1	7,0	Average
Erysiphe cichoracearum DC. f. Helian	Powdery mildew	16,2	8,0	Average
Ascohyta helianthi Abramow	Ascochitosis	17,2	9,0	Average
Alternaria Nees	Alternaria	18,3	8,0	Average
Puccinia helianthi Schw	Rust	20,0	9,0	Average
Plasmopara helianthi Novot.	Fake powdery mildew	25,0	10,0	Average
Phoma helianthi Aleks.	Phomosis	31,3	19,0	Max
Verticillium dahliae Kleb.	Vertical wilting	33,0	22,0	Max
HCP		0,34	0,38	

Analyzing the results of the research, 3 levels of distribution and development of pathogens on sunflower can be determined:

- minimum – up to 10%;
- on average – up to 25%;
- maximum – over 25%.

At the minimum level of development, 0.5-2.0% of the prevalence and 0.01-1.0% of the development of pathogens from ash rot (stem form) and gray rot (basket shape), as well as bacterial wilt – 10% of the spread with 0.5% development.

At the average level of spread and development, such pathogenic organisms appear as:

- *Phomopsis* – 15% of the spread and 7.0% of the development.
- *Septoria* – 16.1% of the spread and 7.0% of the development.
- *Erysiphe* – 16.2% of the spread and 8.0% of the development.
- *Ascochitis* – 17.2% of the spread and 9.0% of the development.
- *Alternaria* – 18.2% of the spread and 8.0% of the development.
- *Rust* – 20.0% of the spread and 9.0% of the development.
- *Powdery mildew* – 25.0% of prevalence and 10% of development.

At the maximum level of prevalence and development are: *Phoma* – 31.3% of the prevalence and 9% of the development and *Verticilosis* – 33% of the prevalence and 22.0% of the development.

CONCLUSIONS

1. Analysis of the pathogenic mycobiota of sunflower in the agro-climatic conditions of the southern steppe of Ukraine allowed us to identify 12 pathogens, including 2 types of rot – gray rot (*Botrytis cinerea* Pers, basket shape) and ash rot (*Sclerotium bataticola* Taub, stem shape). True (*Erysiphe cihoracearum DC. f.* Helian) and false (*Plasmopara helianthi* Novot) powdery mildew was diagnosed on sunflower leaves. Leaf spots have been identified: *Alternaria* Nees, *Ascohyta helianthi* Abramow, *Septoria helianthi* Ell et Keel, *Phoma helianthi* Aleks, *Phomopsis* (*Phomopsis helianthi* Munt.-Cwet). They have their own characteristic shape and color of the spots. *Rust* (*Puccinia helianthi* Schw) in the form of protruding orange pustules was clearly visible on the leaves. *Verticillium dahliae* Kleb developed very actively, in the form of spots on the leaves, turning into wilting of the whole plant. In isolated cases, the bacteriosis manifested itself in the form of black stripes on the stem and oily spots.

2. The analysis of the phytosanitary condition of sunflower allowed us, in addition to the species composition of pathogens, to determine the degree of their spread and development, to identify the dominant species. At the minimum level of development, 0.5-2.0% of the spread and 0.01-1.0% of the development of pathogens from ash rot (stem form) and gray rot (basket form), as well as bacterial wilt are observed, respectively – 10% of the spread and 0.5% of the development. At the average level of spread and development, such pathogenic organisms appear as: fomopsis – 15% of the spread and 7.0% of the development; septoria – 16.1% of the spread and 7.0% of the development; powdery mildew c 16.2% of the spread and 8.0% of the development; ascochitis – 17.2% of the spread and 9.0% of the development; Alternaria – 18.2% of prevalence and 8.0% of development; rust - 20.0% of the spread and 9.0% of the development; powdery mildew – 25.0% of prevalence and 10% of development. At the maximum level of prevalence and development are: phomosis – 31.3% of prevalence and 9% of development and verticilosis – with 33% of prevalence and 22.0% of development.

During periods of changing humidity and high temperatures, there is a possibility of latent development of diseases, some pathogens in the field are insignificant and may not be visually identified. Laboratory phytopathological examination is required. In general, the

weather and climatic conditions during the study period and the varietal characteristics of sunflower did not contribute to the mass development of pathogens.

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