ECOLOGY, BIOTECHNOLOGY, AGRICULTURE AND FORESTRY

IN THE 21ST CENTURY

PROBLEMS AND SOLUTIONS

EDITED BY
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The monograph is a collection of the results of scientists' achievements obtained directly in real conditions. The authors are recognized specialists in their fields, as well as young scientists and graduate students of Ukraine. The studies are conceptually grouped in sections: biotechnology, ecology, agriculture, forestry, sustainable development of the economy and the principles of effective agribusiness. The monograph will be of interest to specialists in biotechnology, ecology, breeding, plant protection, agrochemistry, soil science, forestry, agribusiness, etc., researchers, teachers, graduate students and students of specialized specialties of higher educational institutions, as well as everyone who is interested in sustainable development in the agricultural sphere and Green Deal Implementation strategies.

Keywords: sustainable development, modern technologies, agricultural production, biotechnology, ecology, plant protection, forestry, agribusiness.

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EVALUATION OF MODERN MECHANISMS OF RESISTANCE OF JERUSALEM ARTICHOKE SORT-VARIETIES TO FUNGAL DISEASES

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Confirmed that early dry tuber blotch is caused by a fungi *A. helianthi Keissler*. The best nutritious substrate for the cultivation of fungi *A. helianthi Keissler* is potato-glucose agar, on which natural population manifested high pathogenicity. The disease is more often manifested in the first decade of August. From among all the collective material we have not found any variety with an absolute resistance level. Relevant resistance was found in the following varieties Blanc precoce (France), Vadym (Russia), Kharkiv great-tubered (Ukraine), Maikop (Russia), Iranic (Iran), Potat vilmorim (the USA), Polissia White (Ukraine), Podil 94 (Ukraine), Topilsunflower Start (Ukraine), Nahodka (Russia).

Key words: Jerusalem artichoke (earth pear), Alternaria (early dry tuber blotch), sort-varieties, agent of disease.

Formulation of the problem.

Due to its soil and climatic conditions, Ukraine is favorable for growing Jerusalem artichoke. Jerusalem artichoke (earthen pear) was brought to Ukraine from France in the middle of the 17th century. Currently, this culture is widely cultivated in the USA, Canada, India, China, Afghanistan, Germany, Turkey, Egypt, Australia, Japan and other countries of the world [1]. The yield of green mass of earth pear often reaches 200 t/ha, and the yield of tubers, respectively, 150 t/ha [2–3]. Jerusalem artichoke is widely used for human nutrition, animal and poultry feeding, medicine production, preparation of a variety of dishes, alcohol, ethanol, etc. [4–5].

Based on botanical characteristics, Jerusalem artichoke has more than 200 species, most of which are herbaceous plants 2–5 m tall [6].

One of the main reasons for the decrease in the yield of earthy pear is damage to the vegetative mass and tubers by pathogens of fungal, bacterial, viral and mixed taxonomy. The main means of increasing plant productivity is the creation and introduction into production of varieties with high resistance to harmful microorganisms. Alternaria (early dry spot) is among the most dangerous diseases during the growing season of plants [7–8].

The degree of development of Jerusalem artichoke alternariosis depends on the geographical features of the region, soil and climate, weather conditions, and the degree of resistance of the cultivars. The pathogenesis of pathogens of the genus Alternaria is determined by the degree of damage to the vegetative mass, the reduction of the assimilation surface of the leaves, and the change in physiological and biochemical processes in plants infected with mycoses and bacteriosis. It has been proven that in susceptible years for the development of this disease, leaves, shoots and stems of early and mid-ripening varieties can be affected in the range from 15 to 75%, and late varieties - up to 50%. At the same time, the yield of tubers and green mass, respectively, decreases by 40% or more [9].

Analysis of recent research and publications.

Alternaria of Jerusalem artichoke in the field can often develop in separate foci that gradually spread over the entire field, but the disease is most intense in the center of the foci, which prematurely causes complete browning of the leaves [7–8]. It has been proven that in a complex of factors that influence the development of the pathogen

A. helianthi Keissler is temperature, relative humidity, resistance of cultivars, virulence of isolates of the pathogen and the presence of open

routes of penetration of the pathogen Alternaria helianthi into plant tissues. Most immunologist researchers claim that the most radical method of protecting plants against harmful organisms is the creation of immune and resistant varieties [10–11].

Highlighting previously unsolved parts of the overall problem.

There is no scientific information on the selection of Jerusalem artichoke and the resistance mechanisms of cultivars against Alternaria in the literature. In this regard, for the first time, we performed experiments on testing Jerusalem artichoke varieties for resistance to early dry spot.

The goal is to evaluate Jerusalem artichoke varieties for resistance against Alternaria and to identify highly resistant cultivars.

Research objects and methods. Field experiments on testing varieties, varieties and types of Jerusalem artichoke for resistance to Alternaria were conducted at the experimental field of the Zhytomyr National Agroecological University during 2015–2017.

Evaluation of varieties and types of Jerusalem artichoke for resistance to Alternaria in the field was carried out on leaves by visual records of plant damage, which is carried out annually 3 times per season. It is determined according to the following scale:

9 points – very high resistance (no stains);

8 points – high resistance (single spots on individual leaves);

7 points – relatively high resistance (damage to 25% of the leaf area);

5 points – medium resistance (damage from 25 to 50% of the leaf area);

3 points – low resistance (damage from 50 to 75% of the leaf area);

1 point – very low resistance (damage to more than 75% of the leaf area).

The assessment of Jerusalem artichoke varieties for resistance to Alternaria was carried out in laboratory conditions based on the artificial infection of separated, uninjured leaves with a mixture of isolates of pathogens A. helianthi Keissler.

Research results.

An inoculum load of 20–25 conidia in the field of view of the microscope at 120x magnification. Separated leaves were transferred to a special incubation chamber, which were then placed on racks with daylight lamps. The leaves were laid out on a glass measuring 40x80 cm, previously covered with moistened filter paper. The development of the disease was

monitored for seven days. On the eighth day after leaf infection, the diameter of the affected tissue (mm) and the intensity of sporulation were measured on a three-point scale: 1 point – weak; 2 points - average; 3 points - strong. The lesion index was determined by the formula:

$$X = \frac{1}{n}\left(\frac{a_1 б_1}{в_1} + \frac{a_2 б_2}{в_2} + ... + \frac{a_n б_n}{в_n}\right) = \frac{1}{n}\sum_{i=1}^{n}\frac{a_i б_i}{в_i}$$

where n – is the number of infections;

a – diameter of affected tissue, mm;

$б$ – intensity of sporulation, points;

$в$ – incubation period, days

When conducting experiments on testing Jerusalem artichoke cultivars for resistance against Alternaria, the following varieties-standards of resistance were used, in particular: Interest (relatively resistant) and Skorospilka (susceptible).

As a result of conducting experiments to study the biological features of Jerusalem artichoke alternariosis, we have confirmed that this disease is caused by the fungus A. helianthi Keissler (class Deuteromycetes, order Hyphales, family Dematiaceae), in which the mycelium is septate and consists of thin, colorless hyphae capable of forming at certain conditions of anastamoses. Conidiophores of A. helianthi Keissler are 45–115 μm in diameter, 3–4 μm in diameter, single or collected in bunches, straight, rarely geniculate. Conidia 102–255 × 12–22 μm in size with straight and transverse septa from light olive to brown color. The fungus A. helianthi Keissler often forms round chlamydospores with a diameter of 16–18 μm.

We proved that the best artificial nutrient substrate for the cultivation of the A. helianthi Keissler mushroom is potato-glucose agar, on which the natural population showed high pathogenicity and actively developed colonies with well-defined sporulation.

According to the observations regarding the accounting of earth pear diseases, we have proven that Alternaria most often manifests itself in the first decade of August, first on the leaves of the lower and middle tiers, and later the disease spreads to the shoots and stems of plants.

The symptoms of the damage on the leaves first appeared in the form of small rounded spots up to 4 mm in size, which gradually darkened and later acquired a brown color. The infected tissue became brittle and broke easily. As a result of the strong development of the pathogen A. helianthi Keissler, the leaves completely dried up. On the stems and shoots, Alternaria was manifested in the form of strokes, which in the process of pathogenesis gradually joined, and later formed continuous spots from 3 to 5 cm long.

In the natural conditions of the Polissia zone of Ukraine, we did not detect damage to Jerusalem artichoke tubers by the causative agent A. helianthi Keissler.

When testing Jerusalem artichoke varieties against Alternaria, 22 varieties of domestic and foreign selection and 56 varieties introduced from different regions of Ukraine, Russia, the Baltic States and local populations from among wild, primitive and cultivated species were used in the experiment.

Table 1

A list of the main types of Jerusalem artichoke with high relative resistance against Alternaria (2015–2017)

Name		Country, originator	Degree of damage, score
Varieties			
1	Diyetychnyj	Ukraine	7
2	Lvivskyj	Ukraine	2
3	Kiyivskyj fiolet	Ukraine	7
4	Leningradskyj	Russia	6
5	Topisonyashnyk Start	Ukraine	8
6	Velikoplidnyj	Ukraine	6
7	Nahodka	Russia	6
8	Podilskyj 94	Ukraine	7
9	Zhitomirskyj	Ukraine	7
10	Skorospilka	Russia	6
11	Blank precoce	France	7
12	Iranskyj	Iran	9
13	Patat vilmorin	USA	9
14	Poliskij bilyj	Ukraine	7
Varieties			
15	*Var. purourallus* Cock	USA	7
16	*Var. oblongifolus* Comil	Hungary	8
17	*Var. rubber* Comil	Russia	8
18	*Var. fuseau* Meuris	Turkey	9
19	*Var. patate* Meuris	Lithuania	9
20	*Var. purpureus* Cock	Russia	7

The obtained research results show that from the total number of collection material, we did not find a single variety sample with an absolute level of resistance. Among Jerusalem artichoke varieties, relative stability

(9–7 points) was found in the following: Blanc precoce (France); Vadim (Russia); Kharkiv big potato (Ukraine); Maikopskyi (Russia); Iranian (Iran); Patat vilmorim (USA); Polisky white (Ukraine), Podilsky 94 (Ukraine), Topisonyashnyk Start (Ukraine), Nakhodka (Russia) (Table 1).

Average resistance against Alternaria showed the following varieties: North Caucasian (Georgia), Pasko (Russia), Sunny (Ukraine), Vadim (Russia), White harvest (Latvia).

The degree of damage to them by this disease did not exceed 5 points. Varieties susceptible to Alternaria were: Volzhska (Russia), Kyivska bila (Ukraine), Hybrid 120 (Russia).

Among the wild Jerusalem artichoke species, the following forms showed high resistance (9–8 points) against Alternaria in the species Var. purourallus Cock (2015.5/11; 2015.13/21; 2015.18/23; 2015.20/27; 2015.23/11).

As a result of testing primitive types of Jerusalem artichoke, the highest resistance to Alternaria was found in the following original varieties: Var. oblongifolus Comil (2016.5/32; 2016.9/13; 2016.11/21; 2016.17/25); Var. rubber Comil (2016.19/26; 2016.21/30); Var. fuseau Meuris (2015.6/7; 2015.9/31).

When testing cultivated types of Jerusalem artichoke, high resistance

(1–2 points) was found in the following forms: Var. patate Meuris (2015.12/12; 2015.15/31; 2015.18/26); Var. piriforme Meunis (2015.23/15; 2015.17/9); Var. purpureus Cock (2015.6/13; 2015.11/31).

Therefore, it is advisable to use the mentioned varieties, varieties and types of Jerusalem artichoke in targeted selection for resistance against Alternaria.

Conclusions

1. As a result of establishing the species affiliation of the causative agent of Jerusalem artichoke alternariosis, it was established that early dry spotting is caused by the fungus A. helianthi Keissler.

2. When evaluating Jerusalem artichoke varieties for resistance against Alternaria, the following were selected: Blanc precoce (France); Kharkiv big potato (Ukraine); Iranian (Iran); Patat vilmorin (USA); Polisky white (Ukraine); Topisonyashnyk Start (Ukraine); Kyiv violet (Ukraine); Dietetic (Ukraine); Podilskyi 94 (Ukraine); Skorospilka (Ukraine).

3. On the basis of the test of Jerusalem artichoke cultivars, species and varieties for resistance against Alternaria, the highest resistance (7–9 points)

was shown among: wild species – Var.purourallus Cock; primitive - Var. oblongifolus Comil; Var. rubber Comil; Var. fuseau Meuris and cultivated species – Var. potato Meuris; Var. piriforme Meunis; Var. purpureus Cock.

Prospects for further research. It is expedient to use the specified variety samples in the purposeful selection of Jerusalem artichoke for resistance against Alternaria.

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