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POTATO WART *Synchytrium endobioticum* (Schilb.) Perc. CASUATIVE AGENT DETERMINING AND IDENTIFICATION IN UKRAINE

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Introduction. Potato wart is intercellular obligate pathogen *Synchytrium endobioticum* (Schilbersky) Percival is causative agent of this disease. It is the most dangerous potato disease [1].

This disease is one of reason for serious lack for potato yield throughout the world. It decreases the quality as food and feed crop [2]. Potato production decrease in Ukraine caused the beginning of the war in Ukraine. There were a lot of soil mined by Russian occupants. There was no possibility to treat here. There were a lot of flooded and mulled soils through Kachovka dam explosion. So it was a reason for great decrease of this crop gross production.

The disease's character and hazard depend upon the weather-climatic region [3], agrarian technique usage, level for improving progressive technologies, variety resistance, soil fertility, level seeding [4], system of protective measures.

Potato wart put into the list of quarantine diseases in 38 countries throughout the world, [5,6] as per data of European and Mediterranean Plant Protection Organization (EPPO). There were recorded more than 40 pathotypes of causative agent. [7,8,9,10].

The first causative agent determined in Ukraine in 1938 [1]. The slow. but stable soil infecting increase happened next years. The most rapid disease spread increase recorded in 2006-2008. The causative agent determined in more than 13 regions of Ukraine on area 8307,2 ha. It was caused serious precipitation and followed floods. The area of potato wart sources decreased in 3,5times or on 72% in comparison with 2008. The disease spread in 5 regions, 21 districts, 225

settlements, 8274 on general area 2337,96 ha on 1st January 2022 [11]. The most highest potato wart sources observed in Ukrainian Carpathian region The favorable regional weather-climatic conditions and present practice for monocultural potato growing is one of the reason for species differentiation and new pathotypes forming. This phenomenon appeared during the long-term mixes growing different by resistance to wart potato varieties [12]. The same trend noticed in their works Przetakiewicz J., 2017 [7], in Poland, Çakir E., Demirci F., 2017 [9] -in Turkey, Boberg J., Björklund N. [2]in Sweden.

The common (Dalem) pathotype (D1) (in Chernivtsi region) and four aggressive pathotypes in 11- Mizhirrya, 13- Rachiv, 18- Yasynnya (in Zakarpattia region) and 22- Bystrets in Ivano-Frankivsk region recorded in Ukraine now.

The spreading aggressive pathotypes in mountain areas of Ukraine are able to defeat to 90% resistant to common pathotype potato assortment. That is why potato varieties with complex resistance to disease causative agents propose to grow in sources with aggressive pathotype [14].

The present methods were improved by us and the new techniques for determining and identifying potato wart pathotypes were developed by us on the present stage.

New EPPO Standard PM 7/28(1) [15] and EPPO Standard PM 7/28(2) for *Synchytrium endobioticum* [16] developed for determining and identifying existing in Europe wart pathotypes.

Calcium chloride with specific weight 1,4 and kaolin used for potato wart causative agent extraction as per European standards. [16].Zoosporangium identification conducted by visual evaluation[16].

The express- method for potato wart causative agent extraction with sodium iodide developed for soil with wart sources in Ukraine with low content of organic matters. It was patented and improved in regional phytosanitary laboratories of Ukraine. [17]. The potato wart causative agent conducted by the 0,5% Coomassie brilliant blue solution.

Purpose was to determine and identify pathotypes and new isolates for potato wart in Ukraine.

Materials and methods. Soil samples for determining potato wart causative agents determining conducted in Ukrainian sources as per standard EPPO PM 7/28 (2) [16].6 outlet probes selected from every 0,01 g. They were extracted by improved drill. One mixed probe formed from them.

Soil samples dried at room temperature. They sieved through the sieve with pore diameter 0,5; 0,25 та 0,03см [18].35% sodium iodide with specific weight 1,1 added into the probe and then centrifuged 3 minutes at 3000 rotations per minute. Light impurities floated on surface. Supernatant with impurities poured out 48.5% sodium iodide with specific weight added into precipitation. Then this mix centrifuged 3 minutes at 3000 rotations per minute. Zoosporangium floated on the surface during this process. Then they saved on watch glass and counted under the microscope. The average meaning determined for every probe. The winter zoosporangium was determined through the painting by Coomassie brilliant blue G-250. Viable zoosporania painted into the blue color, and non-viable no [17].

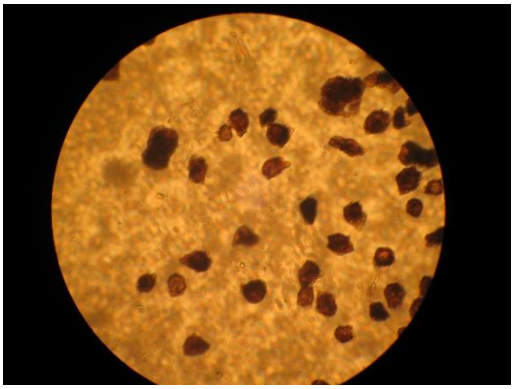
Ukrainian potato test-assortment used for identification potato wart causative agents *Synchytrium endobioticum* (Schilbersky) Perc. Among them were: Poliska rozheva, Slovaynka, Kalynivska, Malynska bila, Schedryk, Chervona ruta, Basis, Santarka, Galzurna, Bozhedar [18].

All experiments conducted in three analytical respectabilities. Statistical probability of received data evaluated with software Statistica 5 usage.

Results. All tubers variety Poliska rozheva from Ukrainian test-assortment differentiating cultivars defeated by zoospores of common (Dalem) pathotype by the results of conducted researches in Ukraine. The following varieties Poliska rozheva, Slovyanka, and Malynska bila (4-5 points) from all test-assortment defeated in village Maydan Mizhirya district Zakarpattia region during the tubers infecting by zoospores. Following cultivar-differentiators: Poliska rozheva, Slovyanka and Malynska bila (4-5 points) defeated during wart zoospores defeating in village Surupy Rachiv district Zakarpattia region. Next cultivar- differentiators: Poliska rozheva, Slovyanka and Schedryk (4–5 points) was defeated under pathogen impact in village Yasynia Rachiv district Zakarpattia region. Among defeated varieties were: Poliska rozheva, Slovyanka, Schedryk, Dyvo and Chervona ruta (4–5 points) in village Bystrets, Verkhovyna district, Ivano-Frankivsk region (table 1). So the potato wart pathotype identification showed the presence of 5 pathotypes in Ukraine. Among them are: D1-common and 4 aggressive pathotypes: 11- Mizhgirya, 13 – Rachiv,18-Yasynya spread in Zakarpattia region and 22 Bystrets, spread in Ivano-Frankivsk region.

The new potato wart causative agent source determined in Storozhinets 2019 on area 0,02 ha with high infectious load (fig.1). It is necessary to identify

new isolate. Among defeated cultivar-differentiators were: Poliska rozheva, Slovyanka, Malynska bila, Dyvo, Chervona ruta and Schedryck by the results of conducted work. This new isolate is not the same as early identified in Ukraine. European test-assortment potato cultivars will use for the identification,



Figigure 1. Potato war causative agent (120^{x})

Table 1. Potato wart causative agents pathotypes identification for Ukrainian potato test-assortment usage.

№ items	Variety name	Resistance group (D1)	Resistance to wart aggressive pathotypes				
			Mizgirya (П)	Rachiv (13)	Yasynia (18)	Bystrets (22)	Storo-zhenets
1.	Poliska rozheva	+ (S2)	+(S2)	+(S2)	+(S2)	+(S2)	+ (S1)
2.	Slovyanka	- (R1)	+ (S1)	+ (S1)	+ (S1)	+ (S1)	+ (S1)
3.	Malynska bila	- (R1)	- (R1)	+ (S1)	- (R1)	- (R1)	+ (S1)
4.	Kalynivska	- (R2)	+ (S1)	- (R1)	- (R1)	- (R1)	- (R2)
5.	Dyvo	- (R1)	- (R1)	- (R1)	+ (S1)	+ (S1)	+ (S1)
6.	Fantsia	- (R1)	- (R1)	+ (S1)	+ (S1)	- (R1)	- (R2)
7.	Chervona Ruta	- (R1)	- (R1)	- (R1)	- (R1)	+ (S1)	- (R2)
8.	Schedryk	- (R1)	- (R1)	- (R1)	+ (S1)	- (R1)	+ (S1)
9.	Santarka	- (R1)	- (R2)	- (R2)	- (R2)	- (R2)	- (R2)
10.	Glazurna	- (R1)	- (R1)	- (R1)	- (R1)	- (R1)	- (R2)
11.	Bozhedar	- (R1)	- (R1)	- (R1)	- (R1)	- (R1)	- (R1)

Conclusions:

1. The existence of 5 potato wart causative agents pathotypes and 1 new isolate showed the researches for their identification with Ukrainian test- assortment usage.
2. The potato wart causative agent isolate identification from t. Storozhinets showed the difference of this isolate from other present pathotypes in Ukraine.
3. It is recommended to use main and additional European potato cultivar test- assortment for potato wart causative agent identification as per EPPO Standard 7/28 (1) та 7/28(2) /2022.

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