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## THE RESULTS OF USING INTERSPECIFIC HYBRIDIZATION TO CREATE VALUABLE SELECTION FORMS OF PATATOES

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**Abstract:** In 2020–2022, an evaluation of newly developed interspecific potato hybrids was conducted on dark gray podzolic light loamy soils (Western Forest-Steppe region) based on their economic and biological characteristics. Sixteen hybrids from different maturity groups, created using the stepwise interspecific hybridization method, were studied. It was determined that careful selection of parental forms for crossbreeding and their rational combination in parental pairs allows for the combination of potentially high productivity (up to 1 kg/plant and higher), intensive yield formation with an increased starch content in tubers (15–17%), and enhanced resistance of above-ground biomass to late blight (at a level of 6–7 points on the international 9-point scale). Based on the conducted research on the comprehensive assessment of economic and biological characteristics of new interspecific potato hybrids, the following hybrids were identified and selected: mid-early hybrid 02/10-40 (Borodyanska Rozheva x *Suzorye*), mid-maturing 11/4-1 (Zakhidna x Vodohray), and late-maturing 16/17-1 [(Zakhidna x *Sante*) x (Volya x Lishchina)]. These hybrids significantly outperform the corresponding standard varieties in terms of a set of economically valuable traits. It is proposed to continue further breeding work with them according to the accepted potato breeding scheme, to intensively propagate them, and prepare them for submission to State Variety Testing as candidates for new varieties of this crop.

**Keywords:** potatoes, breeding, interspecific hybrids, selection, economically valuable traits.

### 1. INTRODUCTION

The diverse use of potatoes underscores the pivotal role it has played and will continue to play in human civilization as a unique and irreplaceable food and industrial crop. Therefore, increasing potato production remains a relevant task for both science and practice.

Increasing potato yields are achieved through the comprehensive implementation of a range of technological, organizational, and material-technical measures. However, potato breeding remains one of the most effective directions for intensifying potato cultivation, as emphasized by plant breeders such as M.D. Goncharov [1], A.A. Osypchuk [6], P.D. Zaviryukha, and others [2,3]. In other words, the creation and introduction of new high-quality potato varieties with high adaptive potential and resistance to biotic and abiotic factors continue to be a relevant task for both domestic and foreign breeding institutions and their breeding programs [4,7].

The Department of Genetics, Breeding, and Plant Protection at Lviv National Environmental University (hereinafter referred to as LNEU) has been engaged in applied potato breeding for over 70 years. During this time, more than 20 varieties of this crop have been developed and introduced into practice. However, the challenges posed by production and the continuous evolution of harmful organisms have led to new demands for the economic and biological traits of new "second bread" varieties.

Given the above, and with the aim of implementing potato applied breeding programs, we are conducting stepwise interspecific crosses to create initial breeding material. The underlying ideology of these crosses is to combine in a single genotype a complex of valuable economic traits inherent to the parental forms.

As a result of the stepwise interspecific hybridization conducted at LNEU, a series of new hybrid potato forms have been created. The research aimed to provide a comprehensive assessment of these new interspecific potato hybrids based on valuable economic and biological traits.

## 2. MATERIALS AND METHODS

The following potato varieties of Ukrainian breeding served as the parental forms in creating the new hybrids under investigation: Borodyanska Rozheva, Vodohray, Volya, Hybridna 14, Zakhidna, Zov, Lishchina, Lvivianka, Oksamyt, Povin, Svitank Kyivsky, as well as foreign varieties *Nevska*, *Suzorye*, *Aminca*, *Sante*, and *SVP* hybrid.

The research was conducted over the course of 2020-2022. Sixteen new potato hybrids of medium-early, medium-maturing, and medium-late biological maturity groups were used for the research. Each hybrid, along with the respective standard potato varieties, was planted in four-row plots with 30 tubers per row, at a plant spacing of 70x35 cm. The experiments were repeated three times. The following standard varieties were used: for the medium-early group – Vodohray, for the medium-maturing group – Volya, and for the medium-late group – Zakhidna. All field and laboratory research was conducted in strict accordance with the methodology for potato research [5].

The agronomy practices on the experimental field were typical and widely accepted for potato cultivation in the Western Forest-Steppe region. An exception was the absence of fungicide application against late blight in order to conduct objective field phytopathological assessments of plant (haulm) resistance to the specified disease. Each year, three field assessments of late blight infection were performed according to the international 9-point scale [5], which includes the following ratings: 9 points – no infection on the above-ground part of plants (haulm); 8 – isolated spots of plant infection; 7 – infection of leaf surface on 5–15% of plants; 6 – infection on 16–25%; 5 – infection on 26–40%; 4 – infection on 41–50%; 3 – infection on 51–70%; 2 – infection on 71–80%, and 1 point – infection of the leaf surface on 81–100% of plants.

## 3. RESULTS AND DISCUSSION

We have found that under identical agrotechnical, agroclimatic, and biotic factors for potato cultivation (soil type, fertilization, cultivation techniques, temperature regime, rainfall, pest infection levels), the absolute values of economic traits are determined by the biological (genotypic) characteristics of the specific hybrid form obtained through interspecific stepwise hybridization.

In particular, based on the study of the final yield of tubers in the investigated potato hybrids of different maturity groups, we identified significant differences both among the hybrids and in comparison with the respective standard varieties (Tab. 1).

Indeed, within the group of medium-early forms, one hybrid stands out with high yields, which is the 02/10-40 hybrid (Borodyanska Rozheva x *Suzorye*). On average, it reached 42.8 t/ha compared to 34.5 t/ha for the standard variety Vodohray. Also deserving further breeding work in the medium-early group is the hybrid 16/1-12 [Svitank Kyivsky x (Zakhidna x Povin)] with a yield of 39.2 t/ha, which is 4.7 t/ha more than the standard yield.

In the group of medium-maturing forms, promising hybrids have been identified with the potential to yield around or above 50 t/ha. This includes the 11/4-1 hybrid (Zakhidna x Vodohray) with a yield of 51.8 t/ha, a 34.8% increase compared to the standard variety Volya, which yields 34.6 t/ha. Another notable hybrid is the 14/16-2 [(Zakhidna x *Aminca*) x (Volya x Lishchina)] with a yield of 48.7 t/ha, which is 10.3 t/ha more than the standard yield.

In the group of medium-late forms, we have identified and selected a promising hybrid, 16/17-1 [(Zakhidna x *Sante*) x (Volya x Lishchina)], for further breeding work. This hybrid has the potential to yield approximately 46.3 t/ha, which is 33.8% higher than the yield of the standard variety Zakhidna.

Tab. 1 .Yield of Interspecific Potato Hybrids of Different Maturity Groups from the Breeding Program at Lviv National Environmental University, average for 2020-2022

Variety Name, Crossbreeding	Breeding Number	Average Yield, t/ha	To St	
			t/ha	%
Medium-Early Maturity Group Hybrids				
Vodohray	<i>St</i>	34,5	-	-
Svitanok Kyivsky x (Zakhidna x Povin)	16/1-12	39,2	4,7	13,6
Zakhidna x (Zov x <i>Nevska</i> )	14/9-30	38,5	4,0	11,5
Borodyanska Rozheva x <i>Suzorye</i>	02/10-40	42,8	8,3	24,0
Medium-Maturing Hybrids				
Volya	<i>St</i>	38,4	-	-
Zakhidna x Vodohray	11/4-1	51,8	13,4	34,8
(Zakhidna x <i>Aminca</i> ) x (Volya x Lishchina)	14/16-2	48,7	10,3	26,8
(Zakhidna x <i>Sante</i> ) x (Volya x Lishchina)	15/5-19	38,4	0	-
Medium-Late Maturity Group Hybrids				
Zakhidna	<i>St</i>	34,6	-	-
[(Hybridna 14 x Lvivianka) x <i>SVP hybrid</i> ] x Zakhidna	11/3-2	40,2	5,6	16,1
Zakhidna x (Borodyanska Rozheva x Oksamyt)	11/15-12	39,2	4,6	13,3
(Zakhidna x <i>Sante</i> ) x (Volya x Lishchina)	16/17-1	46,3	11,7	33,8
HIP <sub>05</sub> , t/ha		1,42	-	-

An important quality indicator of potatoes and the direction of their use for food, feed, and industrial purposes is the starch content in tubers. This economic trait depends on several factors, but the most determining factor influencing its expression is the genotypic characteristics of a particular potato variety (or hybrid). Experimental data supporting this statement are presented in Tab. 2.

The analysis of starch content in tubers indicates that, in absolute terms, some hybrids have a higher starch content compared to the respective standard varieties. In the medium-early maturing group of hybrids, it is advisable to highlight hybrids such as 14/9-30 [(Zakhidna x Zov x *Nevska*)] with 16.3% and 02/10-40 (Borodyanska Rozheva x *Suzorye*) with 17.2% starch content, compared to 13.2% in the Vodohray standard.

In the medium-maturing group, the absolute starch content value of the Volya standard (14.0%) significantly exceeded all the hybrids we studied, especially 14/16-2 [(Zakhidna x *Aminca*) x (Volya x Lishchina)] with 17.0% starch content. The medium-late maturing hybrid 16/17-1 [(Zakhidna x *Sante*) x (Volya x Lishchina)] is characterized by elevated starch content, reaching 17.2% compared to the 15.7% in the Zakhidna standard.

Based on the research results presented in Table 2, a range of new potato breeding hybrids from various maturity groups at Lviv National Environmental University successfully combines high productivity potential, increased starch content in tubers, and high resistance to late blight (*Phytophthora infestans*) with ratings of 8-6 points on the international 9-point scale.

Tab. 2. Starch Content in Tubers and Plant Resistance to Late Blight in Interspecific Potato Hybrids from the Breeding Program at Lviv National Environmental University, averages for 2020-2022

Variety Name, Crossing	Selection Number	Starch Content, %	± to <i>St</i>	Late Blight Resistance, Rating		
				1 rating	2 rating	3 rating
<i>Medium-Early Maturing Group</i>						
Vodohray	<i>St</i>	13,2	-	8	6	5
Svitank Kyivsky x (Zakhidna x Povin)	16/1-12	14,1	0,9	9	7	6
Zakhidna x (Zov x <i>Nevska</i> )	14/9-30	16,3	3,1	8	7	5
Borodyanska Rozheva x <i>Suzorye</i>	02/10-40	17,2	4,0	9	8	7
<i>Medium-Maturing Group</i>						
Volya	<i>St</i>	14,0	-	8	7	5
Zakhidna x Vodohray	11/4-1	15,3	1,3	9	8	7
(Zakhidna x <i>Aminca</i> ) x (Volya x Lishchina)	14/16-2	17,0	3,0	9	9	6
(Zakhidna x <i>Sante</i> ) x (Volya x Lishchina)	15/5-19	16,2	2,9	9	8	7
<i>Medium-Late Maturing Group</i>						
Zakhidna	<i>St</i>	15,7	-	7	6	4
[(Hybrid 14 x Lvivyan-ka) x <i>SVP hybrid</i> ] x Zakhidna	11/3-2	16,9	1,2	8	8	7
Zakhidna x (Borodyanska Rozheva x Oksamit)	11/15-12	14,1	-1,6	9	8	7
(Zakhidna x <i>Sante</i> ) x (Volya x Lishchina)	16/17-1	17,2	1,5	7	7	6
HIP <sub>05</sub> , %		0,35	-	-	-	-

According to three visual field phytopathological assessments, among the medium-early maturing group, hybrid 02/10-40 (Borodyanska Rozheva x *Suzorye*) exhibited strong resistance to late blight. Within the medium-maturing group, hybrids 11/4-1 [(Zakhidna x Vodohray)] and 15/5-19 [(Zakhidna x *Sante*) x (Volya x Lishchina)] demonstrated high resistance to late blight in the above-ground plant parts. Prospective hybrids for late blight resistance in potato breeding might include medium-late maturing hybrids 11/3-2 [(Hybrid 14 x Lviv'yanke) x *SVP hybrid*] x Zakhidna and 11/15-12 [Zakhidna x (Borodyanska Rozheva x Oksamit)]. The selected hybrids from different maturity groups will undergo further breeding work in accordance with the potato breeding scheme and methodology.

#### 4. CONCLUSION

1. The conducted research has shown that interspecific potato hybridization allows for the combination of potentially high productivity (45–50 t/ha and above), intensive formation of tubers with increased starch content (15–17%), and enhanced field resistance of plants (stalks) against late blight (*Phytophthora infestans*), with ratings of 6–7 points according to the final assessment on the international 9-point scale.

2. As a result of comprehensive evaluation of the economic and biological traits of new intervarietal potato hybrids of the Lviv National Environmental University selection, medium-early hybrid 02/10-40 (Borodyanska Rozheva x *Suzorye*), medium-maturing hybrid 11/4-1 [(Zakhidna x Vodohray)], and late-maturing hybrid 6/17-1 [(Zakhidna x *Sante*) x (Volya x Lishchina)] were selected and chosen as they significantly outperformed the respective standards. It is suggested to continue breeding work with these hybrids according to the potato breeding scheme, intensively propagate them, and prepare them for submission to the State Variety Testing as candidates for new varieties of this crop.

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Петро Завірюха, Богдан Костюк, Віктор Вихованець, Юлія Мельник, Галина Мельниченко. Результати використання міжсорткової гібридизації для створення селекційно-цінних форм картоплі. *Журнал Прикарпатського університету імені Василя Стефаника*, 10 (2023), 107-112.

У 2020–2022 рр. на темно-сірих опідзолених легкосуглинкових ґрунтах (зона західного Лісостепу) проведена оцінка нововиведених міжсорткових гібридів картоплі за їх господарськими і біологічними ознаками. Вивчали 16 гібридів різних груп стиглості, створених методом ступінчастої міжсорткової гібридизації. Встановлено, що ретельний підбір вихідних батьківських форм для схрещувань, обґрунтоване поєднання їх у батьківській парі дозволяють поєднати у гібридних нащадках потенційно високу продуктивність (до 1 кг/кущ і вище), інтенсивне формування урожаю з підвищеним умістом крохмалю у бульбах (15–17 %) та підвищеною стійкістю надземної маси проти фітофторозу (на рівні 6–7 балів за міжнародною 9-бальною шкалою). На основі проведених досліджень з комплексної оцінки господарських і біологічних ознак нових міжсорткових гібридів картоплі, виділено і відібрано середньоранній гібрид 02/10-40 (Бородянська рожева x *Suzorye*), середньостиглий 11/4-1 (Західна x Водограй) і середньопізній 16/17-1[(Західна x *Sante*) x (Воля x Ліщина)], які істотно переважають за комплексом господарсько-цінних ознак відповідні сорти-стандарту. Пропонується продовжити з ними подальшу селекційну роботу згідно прийнятої схеми селекції картоплі, інтенсивно розмножувати і готувати для передачі у Державне сортовипробування як кандидатів у нові сорти цієї культури.

**Ключові слова:** картопля, селекція, міжсорткові гібриди, відбір, господарсько-цінні ознаки.