

RESULTS REGARDING THE QUANTITATIVE AND QUALITATIVE TRAITS OF NEW POTATO LINES CREATED UNDER THE EXPERIMENTAL CONDITIONS OF NIRDPSB BRASOV

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Abstract

A evaluation of 5 potato breeding lines was carried out between 2021-2022 to NIRDPSB Brasov. The lines were analyzed from a morphological point of view, the foliage structure falling between the intermediate type (21-1901/7) and the stem type (19-1876/7), with the tubers showing yellow (1941/8) or red skin (19-1876/7) and a pulp color varying from yellow (21-1895/1) to cream (21-19017/). The productions obtained, in different climatic years, were on average between 39.86 t/ha (21-1901/7) and 21.58 t/ha (Brasovia, control variety). To the analyzes carried out, the general appearance of the tubers ranged between 1.03 for line 1895/1, considered the most attractive and 2.63 for line 1901/7, the least attractive. The lines from the class A/B (1895/1 and 1939/2) present tubers that remained whole after boiled, being able to be easily used in salads (boiled potatoes) and other cold dishes. Class B and B/C lines (1901/7, 1867/7 and 1914/8) have tubers that can partially crumble when cooked, have a gummy or mealy consistency and a medium-fine texture. These tubers lend themselves to a wide range of culinary preparations, from mashed potatoes and soups to baked and fried potatoes. The potato lines are well adapted to climatic and soil conditions and were send for testing in the network of National Institute for Testing and Registration of Varieties.

Keywords: potato, breeding, morphological characters, culinary values, yield.

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INTRODUCTION

Potato breeding has like permanent objective the creation of new varieties with high yield capacity, resistant/tolerance to differernt pests and diseases and with qualitative qualities able to satisfy the processors and customers demands. Obtaining new potato varieties is a challenging task, due to the genetic complexity of the potato as an autotetraploid species and the high heterozygosity of the species (Jansky and Spooner, 2018; Ruiz de Arcaute et al., 2022).

During the selection process, the breeder assesses the breeding material in terms of about 50 qualitative, resistance, or agronomic traits, usually independently inherited. It became increasingly difficult to select recombinants in the offspring of tetraploid parents that meet the requirements of the modern variety (Zimnoch-Guzowska et Flis, 2021). Therefore, typically one variety has been selected from around 100,000 clones (Ross 1986) over 11–12 years. Potato production is estimated to be 359 million tons per year all over the world, cropped on 16.5 million hectares (Eurostat, 2021) so it stands as the third most important food-source crop after wheat and rice, and the most

important non-cereal food crop (Devaux et al., 2020).

It is also necessary to improve some important traits in varieties focused on a commercial objective, such as plant maturity and quality traits. A correlation between late plant maturity and higher tuber yield has been reported (Schönhals et al., 2016), but genotypes with early tuber set and faster tuber bulking can better escape diseases severity (Khan et al., 2013), so earliness and good yield might be needed, for instance, in warm environments.

Takes many years to build up sufficient quantities of seed tubers for commercial production and the risk of contamination by pathogens increases with each multiplication step (Lindhout et al., 2011).

Obtaining varieties by categories of use that respond to changing ecological conditions and that require a minimum of chemical treatments, corresponding to a less aggressive technology towards the environment, is the desire that breeders are trying to fulfill (Hermezi, 2019).

Thus, understanding how environmental factors determine growth patterns and production has been one of the most important issues on potato crop research, which aims to help improve the management of agricultural resources (Villa et al., 2020).

MATERIAL AND METHOD

To the NIRDPSB Brasov each breeding cycle starts with a cross between two genotypes, tetraploid varieties, followed by many years of selection and multiplication (Chiru et al., 1992; Hermeziu et al., 2015): seedlings, vegetative populations, descendants, comparative crops (3 years in the network of National Institute for Testing and Registration of Varieties – ISTIS), obtaining the license and registration in the National List of Cultivated Varieties.

The experience was conducted in the fields of the Laboratory of breeding and plant selection, between 2021 - 2022, on a cambic chernozeum soil. In both years the pre-crop was wheat and for fertilizer was used 1000 kg/ha N:P:K:15:15:15+S. The size of the plots was 9 m², the repetition is three-fold, the planting scheme is 75 × 30 cm, having 4 rows with 10 plants each one. Planting was done manually in May 3, 2021 and in April 7, 2022. Treatments for weed control (pre- and post-emergent), for Colorado beetle and for late blight control (alternating systemic products with contact) were applied in accordance with good agricultural practice and specific climatic conditions. No irrigation was used.

The resistance to black wart (*Schynchitrium endobioticum*) was determined at Pojorata Centre Suceava. The starch content and processing quality were determined in the NIRDPSB Brasov laboratory. Also resistance to late blight (*Phytophthora infestans*) and viruses

were determined in the fields and laboratories of NIRDPSB Brasov.

Brasovia variety was chosen like control. It's a mid-early variety, with upright growth habit, white flowers and round-oval tubers with yellow skin, white-yellow flesh and a good yield capacity (30-40 t/ha).

The results were processed by the analysis of variation and the significance of the differences was established by the method of multiple comparisons.

RESULTS AND DISCUSSIONS

The territory where is situated NIRDPSB Brasov is part of the pre-mountain plain of Barsa Country, located in the southeast corner of Transylvania, as a depression surrounded by mountains, crossed from one end to the other by the Bârsa river. The altitude is between 550 and 722 m and the geographical position and the configuration of the relief influence the climate character. The dominant soils are the cambic cernoziomoids (44.9% of the surface) and the relic cambic-glacial cernoziomoids (36.1% of the surface). Bârsa Country is in the transition zone between the Mediterranean and continental climate, being influenced by both types of climates. The weather is determined by the predominance of one or another of these influences (Petricele, 2006; Hermeziu et al., 2020).

Table 1

Air temperature and rainfalls during the experiment

Year	Month						Average
	April	May	June	July	August	September	
2021	6.9	12.3	17.3	21.0	18.5	12.4	16.3
2022	8.3	14.8	19.0	20.6	20.2
MMA	8.5	13.6	16.5	18.1	17.5	13.6	15.9
							Total
2021	39.2	77.0	109.0	71.1	100.8	32.0	389.9
2022	64.8	48.3	62.2	50.1	62.1
MMA	50.0	82.0	96.7	99.8	76.4	52.5	407.4

According to the data taken from Weather Station Ghimbav, in 2021, April was colder than normal and the amount of precipitation that fell was 39.2 mm, which is 10.8 mm lower than the MAA. In May, the air temperature was lower by 1.3°C compared to the multiannual average, and the amount of

precipitation was lower by 4.97 mm compared to the MAA value. June was a rainy month (106,1 mm), with precipitation in the first two decades even daily and with slightly higher temperatures than average (+0.8°C). In July the situation changed completely, registering much higher temperatures (+2.9°C) and a lower level

of precipitation, by 28.7 mm compared to the multiannual average.

In 2022 (Table 1). April start with higher temperature and rainfalls and May was more hot and drier than usually. June was a drier month too, the amount of rainfalls being with 34,5 mm lower compared to the multiannual average (96.7 mm). The months of July (+.5°C more than MAA) and August (2.7°C more than MAA) continued to be warmer than normal and with a low volume of precipitation (less 49.7 mm than MAA in June, respectively less 14.3 mm than MAA in August).

From a morphological point of view, the foliage structure falling between the

intermediate type (21-1901/7) and the stem type (19-1876/7), with the tubers showing yellow (1941/8) or red skin (19 -1876/7), a pulp color varying from yellow (21-1895/1) to cream (21-19017/) and the deep of eyes. The growth habit varied between upright (21-1901/7) to semi-upright (21-1895/1) and the flower color from white (21-1901/7 and 21-1895/1) to purplish pink (1939/2) (Table 2).

Table 2

The morphological characters of the new breeding lines

Breeding line	Foliage structure	Growth habit	Flower color	Tuber classification			
				Shape	Pulp color	Skin color	Deep of eyes
19-1876/7	stem type	upright	light pink	short oval	light yellow	medium red	shallow
1941/8	stem type	upright	light pink	oval	light yellow	yellow	very shallow
21-1901/7	Intermediate type	upright	white	short oval	cream	yellow	very shallow
1939/2	Intermediate type	semi-upright	purplish pink	oval	cream	yellow	shallow
21-1895/1	stem type	semi-upright	white	oval	medium yellow	yellow	shallow

The breeding program developed at the NIRDPSB Brasov imposed the restrictive condition that all varieties to be resistant to potato wart (*Synchytrium endobioticum*), biotype 1, to control this extremely dangerous pathogen. The resistance to wart disease was tested at Pojorata station (Suceava county). According to that tests the presented lines are resistant to potato wart.

From the Table 3 it can be seen that the resistance of the new varieties to viruses is good and very good, similar to the control variety, which enables potato seed production without additional difficulties. The resistance to late blight (*Phytophthora infestans*) on foliage and tubers varied between resistant and medium sensitive.

Table 3

Lines resistance evaluation to leaf roll viruses, PVY and late blight (NIRDPSB Brasov fields)

Breeding line	PVY*	Leaf roll virus*	Late blight*	
			to leaf	to tuber
19-1876/7	8	7	8	9
1941/8	6	7	6	8
21-1901/7	6	6	7	9
1939/2	7	7	7	8
21-1895/1	6	6	6	7
Brasovia	7	7	6	7

* 1- sensitive

9 - very resistant

In 2021, with the exception of line 21-1895/1, all the others recorded higher productions than the control variety, with significantly positive values (19-1876/7 and 1941/8) and significantly distinctly positive (21-1901/7/1939/2).

The yield recorded in 2022 exceeded the control variety to lines 19-1876/7, 21-1901/7 and 1939/2 (Table 4). The main causes

of lower yields are the lack of soil water during tuber growth and the uneven distribution of precipitation during the growing season.

Climatic changes characterized by hot summers and very low volume of rainfalls in the second part of the vegetation period negatively influence the formation and accumulation of potato production.

Table 4

Total yield obtained to the new breeding lines(t/ha)

Genotype	Yield (t/ha)		Dif. (t)		Sign.		Mean
	2021	2022	2021	2022	2021	2022	
19-1876/7	44.10	30.15	20.45	10.65	*	**	37,13
1941/8	43.04	17.19	19.39	-2.31	*	ns	30.11
21-1901/7	45.55	34.17	21.89	14.67	**	***	39.86
1939/2	47.93	30.70	24.27	11.20	**	**	39.32
21-1895/1	29.13	19.33	5.47	-0.17	ns	ns	24.23
Brasovia (control)	23.65	19.50	-	-	-	-	21.58
DL5%	16.24	-	-	6.34	-	-	-
DL1%	21.65	-	-	8.55	-	-	-
DL0,1%	28.20	-	-	11.35	-	-	-

From the average of the two years, it can be seen that all the lines exceeded the control. In 2021, except line 1939/2 all the others lines had higher yield by 20 t/ha. In special climatic conditions (prolonged

drought) from 2022 all lines behaved satisfactorily, line 21-1901/7 having an increase of 14.67 t/ha compared to the control variety.

Table 5

Culinary values of boiled potatoes

Line	Appearance	Taste	Color	Crushing on boiling	Consistency	Mealiness	Moisture	Starch structure	Cooking type
1895/1	1.00	1.38	4.88	1.00	2.75	2.63	2.13	1.50	A/B
1901/7	2.63	2.13	3.88	2.38	2.38	2.88	2.88	2.88	B/C
1867/7	1.00	2.00	5.38	1.25	1.75	3.25	3.00	2.63	B
1939/2	1.13	1.88	4.13	1.13	2.75	2.25	2.00	1.88	A/B
1914/8	1.25	2.00	4.00	1.38	2.00	2.75	2.38	2.25	B

To the analyzes carried out on January 21, 2022, the general appearance of the tubers ranged between 1.03 for line 1895/1, considered the most attractive and 2.63 for line 1901/7, the least attractive. Taste ranged from 1.38 for line 1895/1 rated excellent to 2.63 for line 1901/7 rated good. Crushing on boiling was established according to its behavior. The

tubers of line 1895/1 (1.03) remained whole, and those of line 1901/7 (2.38) crumbled the most among all the analyzed samples. The consistency of the pulp is a measure that expresses the strength of the tubers. The hard ones show a higher resistance (lines 1895/1 and 1939/2 both with a value of 2.75), and the floury ones a weaker resistance (1867/7 with a

value of 1.75). The less mealiness potatoes have a pleasant palatability, while the floury ones are drier and more difficult to swallow. Visually, the less floury potatoes remain whole (line 1895/1 - 2.63), while the floury ones crack very hard (1867/7 - 3.25). Moisture was determined visually by sectioning and ranged from 2.00 at line 1939/2 (considered the wettest) to 3.00 at line 1867/7 (considered the driest). Starch structure was determined by mastication of a potato slice, distinguishing between coarse (line 1901/7 - 2.88) and fine (line 1895/1 - 1.50) tubers. The color ranged from 5.38 (yellow) on line 1867/7 to 3.88 (yellowish) on line 1901/7. The lines from the class A/B (1895/1 and 1939/2) present tubers that remained whole after boiled, being able to be easily used in salads (boiled potatoes) and other cold dishes. Class B and B/C lines (1901/7, 1867/7 and 1914/8) have tubers that can partially crumble when cooked, have a gummy or mealy consistency and a medium-fine texture. These tubers lend themselves to a wide range of culinary preparations, from mashed potatoes and soups to baked and fried potatoes (Table 5).

CONCLUSIONS

The potato lines 1895/1, 1901/7, 1867/7, 1939/2, 1914/8 were bred at the National Institute of Research and Development for Potato and Sugar Beet Brasov. Obtaining them is part of the objective of the potato breeding program, represented by the creation of early varieties, resistant to water stress, immune to wart disease and with high resistance to pests and diseases. Regarding the yield, all the varieties provided good and very good productions (39,86 - 24,23 t/ha) in difficult climatic years.

It should be emphasized once again that the variety represents the most important technological factor. A defense for certified seed from Romanian varieties takes into account their superior adaptability to climate and soil conditions and therefore the possibility of obtaining productions of 40-60 t/ha, constant over time and depending on the area.

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