EVALUATION OF THE PRODUCTIVE POTENTIAL OF SOME EARLY POTATO GENOTYPES ON THE SANDY SOILS OF SOUTHERN OLTENIA

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Abstract

In the 2024 agricultural year, research was carried out on the productive potential of some potato lines for early consumption compared to the production obtained with the Redsec and Ervant variety, in the conditions of the sandy soils of SCDCPN Dăbuleni. The potato lines taken in the study manifested themselves differently, in according to their biological potential and the pedoclimatic conditions of the area. Following the harvest 75 days after the emergence of the potato plants, the lines Ts 09-1441-1525 (which achieved a marketable production of 31.27 t/ha), Ts 16-1515-1856 with 33, 55 t/ha and Ts 16-1526-1883, which achieved an average marketable production of 34.12 t/ha, productions close to that obtained with the control variety Redsec, respectively an estimated production of 42.84 t/ha. The 1895/4 line was also noted with a marketable production of 36.66 t/ha, close to that obtained with the Ervant variety (39.02 t/ha).

Key words**: **early potato, genotypes, average production, sandy soil.

INTRODUCTION

The potato originates from South America and was first encountered in the high and humid regions of Peru and Colombia. It was introduced to Europe from South America after its conquest by the Spanish (1525-1543), with the help of navigators, through Spain and England. It is widely cultivated in the temperate zone (about 1000 varieties), as a food, fodder and industrial plant. The potato is a plant with great ecological plasticity, which can be cultivated in our country in all areas, starting from the south to the north, from the plains to the mountain area. The prospects of early potato production in the world and in Romania depend on a variety of factors, including climate change, technological innovations and market demand. In potatoes, the variety as a biological resource is the most important factor in large productions. The production capacity is an attribute of each variety, both in terms of the quantity and physical quality of the production, as well as in terms of culinary and technological qualities. The production technology does nothing but ensure the realization of the productive and qualitative potential of the variety, creating optimal conditions for plant growth. In Europe, over 9.2 million hectares are cultivated with potatoes, with an average production of 21.9 t/ha. Of the total world surface, 51.4% is cultivated in Europe, 33.8% in Asia, 4.5% in North America, 5.5% in South America, 4.5% in Africa, and 0 in Oceania .3% (Draica, C., et al. 2004). The early potato is one of the most profitable crops. It should be cultivated only in those areas where the environmental factors are favorable for achieving large productions, and the southern area of Oltenia meets the necessary conditions required by the plant's biology. The production potential or production capacity of a variety represents the maximum level of economically useful biomass that a genotype can achieve under optimal growth and development conditions (nutrition, water, climate) and in a environment free of diseases and pests (M. Savatti, N. Nedelea et al. 2004). In the food

strategy, both globally and in our country, the potato is considered one of the most important crops. It is a complex, dietary food, rich in vitamins and mineral salts (Gruia, R., 2017). The potato is grown on different soils, with different degrees of water retention, starting from sandy soils and including clay soils. For potato cultivation, the ideal soil is the well-structured, with proper water drainage, which allows proper root aeration, respectively the development of tubers without root diseases. The variety cultivated, the choice of land, the preparation of the planting material, the planting density, the dose and type of fertilizer applied, as well as the provision of the water source represent only part of the technological factors that lead to the success of potato cultivation on sandy soils, where the conditions of thermo-hydric stress in the summer months bring major damages to the production both quantitatively and qualitatively. The research carried out on the sandy soils of southern Oltenia highlighted the role of variety, fertilization and irrigation in obtaining economically efficient and high quality potato production (Croitoru Mihaela et al., 2014, Dima Milica et al., 2012, Dima Milica et al., 2014, Croitoru Mihaela et al., 2016). Potatoes are harvested according to the type of crop, aiming for the most valuable harvest in each case.

For the area with sandy soils of Oltenia, forced or winterized spring crops, intended for consumption, are preferred. They are harvested, as a rule, before maturity, that is, when most of the tubers have reached an economic size with a minimum weight of about 35 g. Obviously, by harvesting earlier, production is lower than at full maturity, but due to the higher price of new potatoes in the months of May and June, the income per surface unit is higher, or at least equal to that obtained at full maturity. Successful cultivation of early potatoes not only meets the growing demand for potato products, but also allows the crop to thrive in diverse conditions. Overall, early potatoes offer numerous benefits to farmers and the agricultural industry, but achieving successful cultivation requires careful attention to various factors to maximize their potential and contribute to the global food supply chain. The potato production achieved in 2020, of 2.68 million tons - ranked Romania in sixth place in the European Union (EU), the first position being occupied by Germany, with 11.55 million tons, according to the provisional data announced by the Institute National Statistics((https://www.agerpres.ro/economic-intern/2021/04/07/romania-locul-sase-in-ue-la-productia-de-cartofi-si-patru-la-suprafata-cultivata-in-2020--692369).

Weed, pest and disease management is another critical aspect of early potato growing. These crops are susceptible to various weed species that can compete for nutrients and inhibit their growth. The implementation of effective weed control measures is necessary to prevent yield losses. In addition, pests and diseases are significant threats to early potatoes. Farmers must use appropriate pest management strategies and disease prevention techniques to protect their crops and ensure high quality products.

In conclusion, early potatoes are an indispensable crop in the agricultural industry. Their high production capacity, adaptability and versatility make them an attractive choice for farmers around the world. However, successful cultivation requires careful attention to various factors, including land selection, crop monitoring, adequate irrigation and fertilization, and effective weed, pest, and disease management (Ivashova et al. 2020). By implementing these practices, farmers can maximize the potential of early potatoes and contribute to the global food supply chain. In the south of the country, the potato appeared as a novelty of the last decades, with the establishment of irrigation systems. Under irrigated conditions, it was found that the steppe area offers very good growing conditions for potatoes intended for extra-early, early and summer consumption. The potato for early consumption is of particular importance for the plain area in the south of the country, where this crop has become a

true "business" of the farmers here, being one of the most profitable in the area (Aurelia Diaconu, 2019). The variety is the main resource for increasing production, without the continuous and progressive increase in material and energy costs. The practice of potato cultivation throughout the world proves that all potato varieties, by cultivating them year after year, progressively lose their initial production potential, depreciate in quality, degenerate (Aurelia Diaconu, 2009). The production capacity is an attribute of each variety, both in terms of the quantity and physical quality of the production, as well as in terms of culinary and technological qualities. Production technology does nothing but ensure the realization of the productive and qualitative potential of the variety, creating optimal conditions for plant growth (Berindei, 1979). For potatoes for early consumption, around 2400-2800 mc/ha is generally applied, with a watering rate of 250-300 mc/ha (Diaconu Aurelia et al., 2009: Burzo I., 2014). Looking forward, continued research and innovations in agriculture are essential to meet the growing needs of the population and face future challenges (Hill et al., 2021). In a world faced with the climate shock, with the energy and food crisis, the potato remains the most important tuber crop and is expected to be a solution to ensure global food security for the coming decades (https://potato.ro/_publicatii_files /cartoful_in_ro/cartoful%20in%20RO%20vol18nr1,2.pdf).

The development of early potato varieties resistant to variable environmental conditions and adapted to market requirements can contribute to more stable and sustainable production.

MATERIALS AND METHODS

In 2024, technical works were carried out corresponding to the planting of breeding material for the establishment of the experimental field and for the study of potato lines in the climatic conditions of the year. Four potato lines subjected to the improvement process by INCDCSZ Brașov were studied, respectively Line 1901/12, Line 1895/4, Line 1927/1 and Line 22-1941/8 and the Ervant control variety, and from SCDA Târgu-Secuiesc lines Ts 09-1441-1525, Ts 16-1515-1856, Ts 16-1527-1867, Ts 16-1526-1883 and Ts 12-1489-1576, which were compared with the variety Redsec (control) and were studied in comparative culture on sandy soils from Dăbuleni. The monofactorial experiment was located on a sandy soil with reduced fertility, under sprinkler irrigation conditions, according to the randomized block method. The tubers were planted on february 22, 2024, by mechanized opening of the furrows, manual planting of sprouted tubers and then mechanized covering of the furrows. The distance between rows was 70 cm, and between tubers per row 25 cm, achieving a planting density of about 57,000 nests/ha.

In order to ensure early harvesting, the tuber sprouting work was carried out one month before planting in the field. Thus, by planting sprouted tubers, conditions were ensured for the harvesting of tubers in June, thus avoiding the subjection of the crop to the periods of drought and heat in the months of July-August characteristic of the southern part of the country. Observations and experimental determinations were made regarding:

- early potato production;
- the state of soil fertility.

The following determinations were made: the number of tubers/nest, the average weight of a tuber, the marketable and non-marketable productions, expressed in t/ha and determined in three harvest periods

(45, 60 and 75 days after potato emergence).

Soil samples were collected at a depth of 0-50 cm, and the following determinations were made in the laboratory:

-total nitrogen – Kjeldahl method;

-extractable phosphorus (P-AL) – the Egner – Riem Domingo method

-organic carbon – method of wet oxidation and titrimetric dosing (according to Walkley – Blak in Gogoaşa modification);

- soil pH, potentiometric method.

RESULTS AND DISCUSSIONS

From a climatic point of view, the year 2024 can be characterized as a dry year.

Climatic data recorded at the Weather Station of SCDCPN Dăbuleni between January and May 2024 showed an average temperature of 8.5 ^{0}C and an absolute maximum of 22 ^{0}C in February(table 1).

Table 1. Analysis of the climatic conditions at SCDCPN Dăbuleni during the period january - may 2024

Climatic element	***I***	***II***	***III***	***IV***	***V***	***Average***
Average temperature ^{0}C	**0,5**	**8,5**	**9,25**	**15,2**	**16,7**	**10,03**
The absolute maximum ^{0}C	**16,1**	**22**	**29**	**34,1**	**28,6**	**25,96**
The absolute minimum ^{0}C	**-12,9**	**-7,1**	**-3,1**	**2,7**	**7,4**	**-2,6**
Rainfall mm	**100**	**100**	**100**	**99,6**	**100**	**99,92**
Rainy days	**39**	**11,2**	**36,6**	**36**	**114**	**47,36**
Moisture %	**19**	**8**	**11**	**7**	**15**	**60**
Multiannual average temperature (1956-2023) ^{0}C	**-1,303**	**1,2 99**	**5,919**	**11,916**	**16,943**	**5,754**
Rainfall Multi-year monthly average (1956-2023) mm	**36,297**	**32,104**	**40,611**	**46,967**	**63,415**	**43,777**

The amount of precipitation that fell in May exceeded the multiannual monthly amount (1956-2024) by 50.59 mm, during the January-May period, 60 days with precipitation were recorded.

Ideally, the soil should be loose, more than 25 cm deep and have good surface and internal drainage. Soil chemical properties are less limiting than structural properties in obtaining good yields. In the years 2023-2024, total nitrogen varied between 0.05 – 0.07%, indicating a reduced state of soil supply with total nitrogen (table 2).

Table 2. Soil fertility status in 2024

Depth (cm)	Total nitrogen (%)	Extractable phosphorus (ppm)	Exchangeable potassium (ppm)	Organic carbon (%)	pH
0-25	0,07	79,66	96	0,79	7,32
25-50	0,05	97,36	102,4	0,65	7,12
Supply status					
Low	<0,10	8,1 - 18	<66	<0,58	
Medium	0,11 - 0,15	18,1 - 36	66,1 - 132	0,59 - 1,16	
Normal	0,16 - 0,20	36,1 - 72	132,1 - 200	1,17 - 2,32	
Very good	0,21 - 0,30	72,1 - 144	200,1 - 400	2,33 - 4,64	

Extractable phosphorus was between 79.66 - 97.36 ppm, indicating a very good state of soil fertility. Good phosphorus nutrition leads to the development of a rich

root system, having a positive influence on plant growth.

Exchangeable potassium varied between 96 – 102.4 ppm, indicating a medium fertility state. Organic carbon ranged from 0.65 – 0.79%, indicating a medium supply condition, while pH ranged from 7.12 – 7.32, the means were close, indicating a slightly alkaline reaction.

The emergence of the potato lines took place starting from April 1st in the year 2024.

The best growth rate of the plant in the two years, calculated from the emergence of the potato varieties, was recorded in the Ervant variety (1.140 cm/day) and the Ts 16-1526-1883 line (0.984 cm/day). The other lines recorded a growth rate close to that of the Ervant variety (fig. 1).

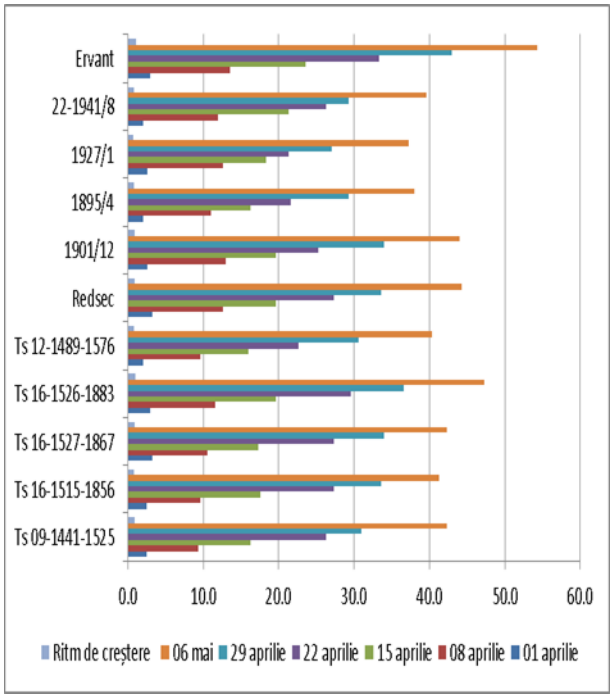

Figure 1. Grow rate at the genotypes

At 45 days after emergence, marketable yields ranged between 11.42 t/ha for line 22-1941/8 and 31.87 t/ha for line L 1895/4. Marketable productions above the genotype average were also achieved by the lines Ts 09-1441-1525, Ts 16-1515-1856, Ts 16-1527-1867 and 1927/1, as well as the varieties Redsec and Ervant (figure 1), and from the point of view statistically only the 22-1941/8 line differed significantly negatively compared to the control (table 3).

Table 3. The production capacity of the potato lines grown on the sands of Dăbuleni
45 days from emergence (May 15, 2024)

Genotype	Production (t/ha)	Diference (t/ha)	Significanc	No. average of large tubers / nest	Average weight of a marketable tuber (g)
Ts 09-1441-1525	25.48	1.51	ns	8	55
Ts 16-1515-1856	25.27	1.30	ns	2	35
Ts 16-1527-1867	24.00	0.03	ns	2	53
Ts 16-1526-1883	24.22	0.25	ns	5	62
Ts 12-1489-1576	15.97	-8.00	ns	3	40
Redsec	27.67	3.70	ns	5	69
1901/12	21.29	-2.68	ns	3	67
1895/4	31.87	7.90	ns	5	69
1927/1	27.09	3.12	ns	5	56
22-1941/8	11.42	-12.55	0	1	56
Ervant	29.41	5.43	ns	2	77
Media genotipurilor	23,97	(mt.)			
LSD 5%=9.34; LSD 1%=12.69; LSD 0,1 %=17.20					

The average weight of a tuber was between 35 g for the Ts 16-1515-1856 line (this being the minimum weight from which potato tubers were considered marketable at the first harvest) and 77 g for the Ervant variety. Analyzing from the point of view of

the production obtained 45 days after emergence, the lines Ts 09-1441-1525 and Ts 16-1515-1856 (with 25.48 t/ha and 25.27 t/ha, respectively) achieved production comparable to the Redsec control (27.67 t/ha), and the 1895/4 line, with 31.87 t/ha obtained 45 days after emergence, surpassed the Ervant control variety (29.41 t/ha) by 2, 46 t/ha.

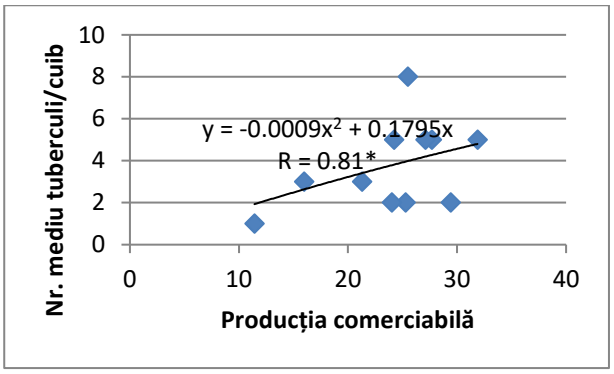

Figure 2. Correlation between marketable production and number of large tubers/nest

The average number of large tubers obtained from a nest was between 1-8, the marketable production obtained at this harvest correlating significantly positively with the number of large tubers harvested (figure 2). The production of small potatoes, under STAS, was between 8.11 t/ha in the line Ts 16-1527-1867 and 27.09 t/ha in the line 1927/1, with an average of the genotypes of 13.91 t/ha ha of small, unmarketable potatoes (table 4). The difference from the average non-marketable production at 45 days after emergence was statistically assured to be highly significant in the case of the 1927/1 line.

Regarding the production of tubers 70 days after emergence, the Redsec variety obtained the highest production (42.84 t/ha), followed by the Ervant variety with a marketable production of 39.02 t/ha, reported at a density of 57,142 plants/hectare, with a number of 7 large tubers/nest and an average weight of a tuber of 111.9 g (table 5).

Table 4. Non-marketable production at the first harvest (45 days from emergence)

Genotype	Production (t/ha)	Diferenc e (t/ha)	Semnificatio n
Ts 09-1441-1525	16,74	2,83	ns
Ts 16-1515-1856	18,44	4,53	ns
Ts 16-1527-1867	8,11	-5,81	ns
Ts 16-1526-1883	15,74	1,83	ns
Ts 12-1489-1576	13,46	-0,45	ns
Redsec	11,98	-1,94	ns
1901/12	13,69	-0,22	ns
1895/4	9,39	-4,52	ns
1927/1	27,09	13,18	***
22-1941/8	10,15	-3,76	ns
Ervant	8,23	-5,68	ns
Media genotipurilor	13,91	(mt.)	
LSD 5%=6.25; LSD 1%=8.49; LSD 0,1 %=11.51			

The studied genotypes differed from each other, but compared to the average of the genotypes there were no significant differences from a statistical point of view.

From 70 days after emergence, the growth of the tubers decreased in intensity and the vines dried up.

Analyzing from the point of view of the production obtained 70 days after emergence, the lines Ts 09-1441-1525, Ts 16-1526-1883 and Ts 16-1515-1856 (with 31.27 t/ha, 34.12 t /ha respectively 33.55 t/ha) achieved productions comparable to the Redsec control (42.84 t/ha), and line 1895/4, with 36.66 t/ha obtained 70 days after emergence, achieved productions

close to those of the control variety Ervant (39.02 t/ha) (figure 3).

Table 5. Results regarding the production of marketable tubers achieved 70 days after emergence

Genotype	Production (t/ha)	Diference (t/ha)	Significanc	No. average of large tubers / nest	Average weight of a marketable tuber (g)
Ts 09-1441-1525	31.27	-1.84	ns	5	89,7
Ts 16-1515-1856	33.55	0.44	ns	4	85,3
Ts 16-1527-1867	29.12	-3.98	ns	4	97
Ts 16-1526-1883	34.12	1.02	ns	3	75,8
Ts 12-1489-1576	28.46	-4.64	ns	4	74,3
Redsec	42.84	9.73	ns	6	100,6
1901/12	25.61	-7.50	ns	3	84,9
1895/4	36.66	3.56	ns	5	119,7
1927/1	32.62	-0.48	ns	3	66,4
22-1941/8	30.89	-2.22	ns	5	87,7
Ervant	39,02	5,91	ns	7	111,9
Average of genotypes	38,11	(mt.)			
LSD 5%=10.87; LSD 1%=14.78; LSD 0,1 %=20.03					

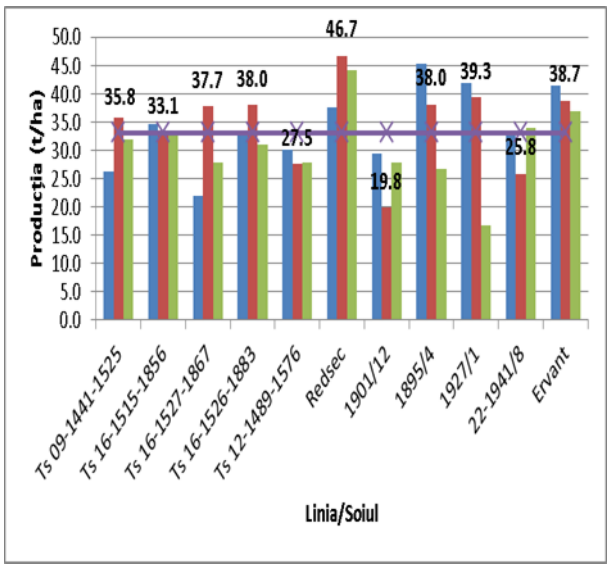

Figure 3. Graphic representation of production obtained 70 days after emergence

At 70 days after emergence, the production of small, non-marketable tubers ranged from 5.0 t/ha in the variety Ervant to 22.60 t/ha in the line Ts 16-1526-1883 (Table 6).

Table 6. Results regarding the production of marketable tubers

Genotype	Production (t/ha)	Differen ce (t/ha)	Semnificati on
Ts 09-1441-1525	9.68	-2.97	ns
Ts 16-1515-1856	18.43	5.77	ns
Ts 16-1527-1867	7.62	-5.04	ns
Ts 16-1526-1883	22.60	9.94	**
Ts 12-1489-1576	14.34	1.68	ns
Redsec	12.25	-0.41	ns
1901/12	11.63	-1.03	ns
1895/4	6.33	-6.32	ns
1927/1	22.11	9.45	*
22-1941/8	9.23	-3.43	ns
Ervant	5.00	-7.66	o
Average of genotypes	12,66	(mt.)	
LSD 5%=7.23; LSD 1%=9.82; LSD 0,1 %=13.31			

The studied genotypes differed from each other, and compared to the average of the genotypes, distinctly significant positive differences were established in the case of

the average production obtained in the Ts 16-1526-1883 line and positively significant in the 1927/1 line, and in the case of the Ervant variety , the differences were statistically significantly negative.

CONCLUSIONS

In the climatic conditions of 2024, the best results were obtained with Ts 16-1515-1856, Ts 09-1441-1525 and 1895/4, as well as with the two control varieties Redsec and Ervant. Realizing an average of the marketable productions obtained with these lines during the 3 harvests, results were obtained between 32.44 t/ha for the Ts 09-1441-1525 line and 41.97 t/ha for the Evant variety.

The potato genotypes studied showed different results according to their biological potential. The commercial appearance and size of the tubers of line 22-1941/8 and 1901/12 stood out, as well as the Ervant variety for the white-skinned genotypes and the tubers of the Ts 09-1441-1525, Ts 16-1527-1867 line and the Redsec variety for red-skinned genotypes.

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