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RESEARCH ON THE BEHAVIOR OF SOME SWEET POTATO GENOTYPES CULTIVATED ON THE SANDY SOILS OF SOUTHERN ROMANIA

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Abstract

In order to increase the degree of food security in the areas affected by thermohydric stress in Romania, the aim is to identify new species of plants that can optimally exploit the microclimate of the area, through their biological potential. The pedoclimatic conditions recorded in the southern part of Romania offer an optimal microclimate for the growth and development of the sweet potato plant (Ipomoea batatas), which is a thermophilic plant, specific to tropical and subtropical areas. Research carried out between 2020-2022 on the sandy soils of southern Oltenia, showed that the sweet potato genotype s studied behaved differently in terms of tuber quality, accumulating a total amount of dry matter between 27% for the variety JUHWANGMI and 46.98% in the variety HAYANMI, with a variety average of 35.35%. Obtaining competitive productions is influenced by the choice of the most suitable sweet potato genotype for the area of sandy soils in S-W Oltenia. The average production for the three years of the study showed values between 17804 kg/ha for the DCh 19/3 genotype and 53368 kg/ha for the DK 19/1 genotype.

***Key words**: sweet potato, genotypes, sandy soil, production, diseases.*

INTRODUCTION

The sweet potato (*Ipomoea batatas* L.) belongs to the *Convolvulaceae* family, together with flowering plants such as morning glory (*Ipomoea purpurea* and other species of *Ipomoea*) and is related to perennial weeds, such as the swallowtail (*Convolvulus arvensis*), being originally from Central America and northwestern part of South America. The sweet potato combines a number of advantages that make it a plant with an important role in the sustainability of food security, being at the same time a key element for improving nutritional standards and generating sources of income (Ewell P.T., 2002).

The variable nature of the climate in the area of sandy soils, especially the lack of precipitation, as well as the low fertility of sandy soils, determines that the production obtained from some agricultural crops on fairly large areas is greatly reduced. In order to obtain high, safe and stable productions, it is necessary to choose the assortment of plants, the varieties with high adaptability to different climate and soil conditions. In this context, at RDSPCS Dăbuleni, research was initiated regarding the testing of some Korean sweet potato genotypes (*Ipomoea batatas*), using different planting seasons, in order to develop the culture technology and promote this plant in the area. The sweet potato fulfills a number of core roles in the global food system, all of which have fundamental implications for meeting food demands, reducing poverty and increasing food security (El - Sheikha and Ray, 2017). Sweet potato roots have high nutritional value and sensory versatility in terms of taste, texture and flesh color (white, cream, yellow, orange, purple). Varieties high in dry matter (> 25%), white flesh color and firm texture after cooking are preferred by consumers in the tropics. These varieties are known as tropical sweet potatoes. Asian specialty types are purple-fleshed sweet potato varieties with an attractive color and high anthocyanin content. In the United States, the popular type is the orange-fleshed potato with low dry matter content (18-25%), high β-carotene, firm texture and sweet taste. According to HUMAN (1992), sweet potato varieties, depending on the duration of the vegetation period, are divided into: early or precocious (90-120 days vegetation period), intermediate (121-140 days) and late (over 140 days of when planting in the field). Sweet potato (*Ipomoea batatas* [L.] Lam) is a drought-resistant plant with vigorous growth and high productivity, adaptable to sandy soils (Iamandei Maria et al., 2014; Diaconu Aurelia et al., 2016), being the least vulnerable crop to climate change because *Ipomoea batatas* plants grow well at higher temperatures than other crops (Hahn, 1977; Date and Eronico, 1987; Waribo and Ogidi, 2014). The sweet potato is attacked by approximately 300 species of anthropods that can cause severe production losses (Talekar, 1991), but also by more than 30 diseases (Clark & co., 2013; Johnson & Gurr, 2016), and plants infested with *Fusarium oxysporum* has been detected in the culture established at SCDCPN Dăbuleni since 2016 (Boiu-Sicuia et al., 2017). In the conditions of the sandy soils of southern Oltenia, the sweet potato varieties studied behaved differently in terms of tuber quality, depending on the variety and climate conditions. Truong D. et al., 2018, showed that the nutritional composition of sweet potato tubers varies greatly depending on the cultivar, growing conditions, maturity and storage. In general, sweet potato tubers have a high moisture content with an average dry matter content of 25-30%. Tsou and Hong, 1992 and Brabet et al., 1998 reported a wide range of total dry matter content of 13-45% from a collection of sweet potato germplasm and Bradbury and Singh (1986) reported values between 9.5 and 25.0 mg/100 g for ascorbic acid and 7.3-13.6 mg/100 g for dehydroascorbic acid, resulting in a total vitamin C range of 7.3-34.5 mg/100 g for sweet potato roots. There is great variability in sugars between sweet potato genotypes. Truong et al., 1986, found total sugars ranging from 5.6% in a Philippine cultivar to 38% in a Louisiana cultivar by dry weight. Sucrose, glucose, and fructose make up most of the total sugars in sweet potato tubers.

MATERIALS AND METHODS

In order to evaluate the behavior to abiotic factors, research was carried out at RDSPCS Dăbuleni between the years 2020-2022, which aimed at the behavior of 5 sweet potato varieties of Korean origin (KSP 1, KSC 1, YULMI , JUHWANGMI, HAYANMI) and five genotypes, namely DK 19/5, DK 19/4, DK 19/1, DK 19/2, DCh 19/3 in the area of sandy soils in the South of Oltenia. The monofactorial experiment was located on a sandy soil with low fertility, protected with PE mulch, under drip irrigation conditions, according to the randomized block method, with 3 repetitions. The size of the variant was 7.65 m^2 and contained a number of 30 plants, arranged in 3 rows.

Variants studied: A total of 10 cultivars were studied, of which seven semi-late genotypes with white flesh (respectively KSP 1, KSC 1, YULMI, HAYANMI, DK 19/4, DK 19/1 and DK 19/2), two early genotypes with yellow (JUHWANGMI and DK 19/5) and a semi-late genotype with purple flesh, respectively DCh 19/3. The geographic coordinates for the place where the experiences took place are: North Latitude: 43° 48′ 04″, East Longitude: 24° 05′ 31″. The experiment was established by shoots produced in the greenhouse. After March 20, when the soil temperature exceeded 10^0C, the tubers were planted in a double-walled greenhouse, where the temperature and air humidity were controlled, in land treated with the product Basamid G, a soil sterilizer with nematocidal, insecticidal, fungicidal and secondary, herbicidal action. In this sense, the product was applied at the beginning of March when the temperature exceeded 6^0C, in a dose of 5 kg/100 m^2, by spreading on the surface of the wet soil, then being incorporated into the soil with the tiller. To stimulate the herbicidal action and to retain the sterilizing gas as long as possible in the soil, the treated soil surface was covered with PE film until March 21. The tubers were planted in a patterned layer, with double protection under the tunnel. A mixture of black soil + sand + peat was used, in a ratio of 1:1:1. Optimum microclimate conditions were ensured, through repeated watering, protection with transparent PE mulch and ventilation, for the creation of vigorous and good shoots for planting in the field. Planting of the shoots was carried out on May 19, in billoned land, protected with smoky PE foil. The land billoning was carried out with MPB 3

+Steyer, which executes 3 rows of billons in one pass. It was fertilized with N150P80K80, during soil preparation, before plowing, using 250 kg/ha of Ammonium Nitrate and 500 kg/ha NPK 16:16:16. Irrigation was carried out by drip and it was aimed to ensure a minimum humidity ceiling of 75-80% of the range of active humidity, and the harvesting of tubers was carried out after 120 days from planting. Tuber samples were collected 120 days after planting, and the following determinations were made in the laboratory:

1. water and total dry matter (TDM) (%) - gravimetric method;
2. soluble dry matter (SDM) (%) - refractometric method;
3. soluble carbohydrates (%) - Fehling Soxhlet method;
4. vitamin C (mg/100g s,p) - iodometric method;
5. starch (%) - gravimetric method.

RESULTS AND DISCUSSIONS

In the field, the ten genotypes had a shoot growth rate ranging from 1.57 cm/day in the DK 19/5 line to 2.71 cm/day in the KSC 1 variety (Figure 1).

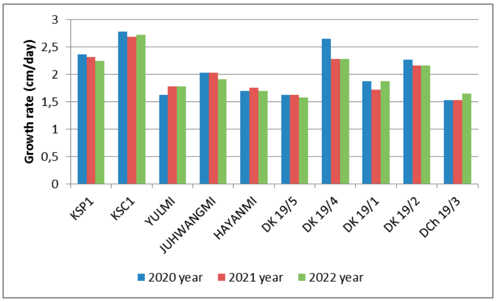

Figure 1. Shoot growth rate in the field (cm/day)

Following the biometric determinations carried out during the experiment 60 days after planting the shoots in the field, the length of the plants had values between 75 cm (at YULMI) and 132.1 cm (at KSC 1), the number of shoots/plant between 4, 6 (at YULMI) and 7.6 at DK 19/5, number of leaves/plant - between 40.65 at YULMI and 66.8 at KSC 1 and petiole length - between 13.3 cm at KSC 1 and 24.7 cm at DK 19/4 (Table 1). Following the harvests to determine the dynamics of tuber weight accumulation, 90 days after planting, the percentage of large tubers had values between 7.40% at KSC 1 and 100% at DCh 19/3.

Table 1. Biometric determinations 60 days after planting in the experimental field

Variant	Plant leght (cm)	Number of shoots	No. Leaves/ plant	Petiole length (cm)	Distance between internodes (cm)
KSP1	115	5.3	56.8	21.3	5.3
KSC 1	132.1	6.3	66.8	13.3	4.6
YULMI	75	4.6	40.65	21.6	4.3
JUHWANGMI	85	5.6	53.65	23.8	7.1
HAYANMI	78	7	48.5	19.6	5.7
DK 19/5	85	7.6	41.3	21.6	4.7
DK 19/4	119	7	46.8	24.7	4.5
DK 19/1	87	7.3	43.5	18.7	4.4
DK 19/2	112	6.3	43.3	16.6	4.2
DCh 19/3	95.1	5.1	43.8	18.7	4.5

The average weight of the tubers high between 0.105 kg/plant at HAYANMI and 0.648 kg/plant at DK 19/1 and plant height was between 0.73 m at DK 19/1 and 2.23 m at KSC 1. At 100 days after planting, the percentage of large tubers of had values between 33.3% at KSC 1 and 70% at DK 19/2, the average weight of large tubers between 0.231 kg/plant at DCh 19/3 and 1.180 kg/plant at DK 19/4 and plant height was between 0, 89 m at DK 19/1 and 2.18 m at KSC1. At 110 days, the percentage of large tubers ranged from 23.07%- at KSP 1 to 100% at DK 19/2, the average weight of large tubers between 0.168 kg/plant at KSP 1 and 1.358 kg/plant at JUHWANGMI and the waist of plants was between 0.93 m at DK 19/5 and 2.51 m at KSP 1. At 120 days, the percentage of large tubers ranged from 40.9 % at YULMI to 91.6 % at DK 19/2, the average weight of large tubers between 0.393 kg/plant at DCh 19/3 and 2.168 kg/plant at DK 19/1 and plant height was between 135 cm at HAYANMI and 271 cm at KSC 1 (Table 2).

Table 2. Gravimetric determinations 120 days after planting

Variant	Large tubers (weight>250 g)				Plant height (cm)
	Percent (%)	Weight (kg)	Diameter (cm)	Length (cm)	
KSP1	43.75	0.680	4.8	19.3	256
KSC 1	52.94	0.990	6.7	31	271
YULMI	40.9	0.930	6	24.3	136
JUHWANGMI	50	0.513	4.6	26.2	176
HAYANMI	46.15	0.575	5.8	24.3	135
DK 19/5	50	0.515	5.4	21.4	152
DK 19/4	81.8	0.596	7.1	21.6	142
DK 19/1	66.6	2.168	7.1	20	139
DK 19/2	91.6	2.075	7.4	15	155
DCh 19/3	44.4	0.393	4.3	18.5	161

The average production estimated after harvest at 90, 100, 110 and 120 days after the final planting of sweet potato shoots in the field, showed a high production potential of the DK 19/1 line compared to the other varieties (Figure 2).

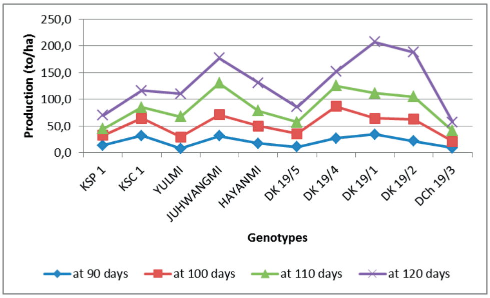

Figure 2. Estimated production at harvests from experience (kg/ha)

The average of the productions estimated after harvesting the experience for each variety separately, at the 3 repetitions, showed values between 15860 kg/ha for the DCh 19/5 genotype and 57640 kg/ha for DK 19/1 (Table 3).

Table 3. Determination of average production between 2020-2022 years

Variant	2020 year (t/ha)	2021 year (t/ha)	2022 year (t/ha)	Average production 2020-2022 (t/ha)
KSP1	17.9	18.2	24.5	20.2
KSC 1	19.2	18.8	16.9	18.3
YULMI	34.7	23.4	32.9	30.3
JUHWANGMI	42.7	63.4	53.9	53.3
HAYANMI	26.5	16.7	21.5	21.6
DK 19/5	23.4	21.8	13.4	19.5
DK 19/4	37.0	62.8	46.5	48.8
DK 19/1	41.1	75.4	43.6	53.4
DK 19/2	27.7	41.2	36.7	35.2
DCh 19/3	16.1	19.6	17.8	17.8

The results obtained by carrying out the statistical calculation on the valorization of experiences placed in randomized blocks, with a single factor, showed a significant difference for JUHWANGMI, DK 19/1 and DK 19/4 compared to the average of the varieties (Table 4).

The high production potential of the JUHWANGMI variety, but also of the DK 19/1 and DK 19/4 genotypes, introduced into culture in 2018, was observed.

The higher the amount of total dry matter (TDM) in the tubers, the lower the amount of water, but sweet potato tubers have a high level of moisture (53.02% in HAYANMI variety and 73% in JUHWANGMI variety). The amount of soluble dry matter (SDM) in sweet potato tubers ranged from 9.6% JUHWANGMI to 12% DCh 19/3, with a cultivar average of 35.35%.

Table 4. The influence of the variety on the production results obtained

Variant	Average of production (to/ha)	Difference		Semnification
		to/ha	%	
Control variant	31.838	Mt	100	
Variant	Average of production (t/ha)	Difference		Semnification
		To/ha	%	
KSP1	20.2	-11.638	63.4	
KSC 1	18.307	-13.531	57.5	
YULMI	30.347	-1.491	95.3	
JUHWANGMI	53.32	21.482	167.5	*
HAYANMI	21.56	-10.278	67.7	
DK 19/5	19.51	-12.328	61.3	
DK 19/4	48.76	16.922	153.2	*
DK 19/1	53.37	21.532	167.6	*
DK 19/2	19.511	-12.327	61.3	
DCh 19/3	17.8	-14.038	55.9	

LSD 5%=15.467 t/ha;
LSD 1%=21.987 t/ha;
LSD 0.1 %=31.836 t/ha.

Varieties with a higher amount of soluble dry matter (SDM) also showed a higher amount of soluble carbohydrates: YULMI (9.46%), DK 19/5 (10.00%) and DCh 19/3 (10.33%) (Table 5). As for starch content, it ranged from 11.10% in the YULMI variety to 14.39% in the DK 19/4 variety, with an average of 12.59%. Sweet potatoes are a source of vitamin C for the human body. Under the climatic conditions of 2020-2022, the amount of vitamin C in the tubers ranged from 8.70 mg in YULMI variety to 11.44 mg in DK 19/4 and DK 19/2 varieties, with an average of 10.11 mg.

Table 5. Biochemical composition of potato tubers according to genotype

Variant	Water (%)	Total dry matter (%)	Soluble dry matter (%)	Soluble carbohydrates (%)	Starch (%)	C vitamin (mg/ 100 g s,p*)
KSP1	62.38	37.62	10.6	9.14	11.55	9.68
KSC 1	60.43	39.57	11.0	9.42	13.21	10.56
YULMI	62.05	37.95	11.0	9.46	11.10	8.70
JUHWANGMI	73.00	27.00	9.6	8.27	13.61	9.68
HAYANMI	53.02	46.98	10.4	8.95	11.72	10.56
DK 19/5	69.27	30.73	11.6	10.00	12.33	10.56
DK 19/4	66.67	33.33	10.8	9.30	14.39	11.44
DK 19/1	70.34	29.66	10.7	8.80	13.25	9.68
DK 19/2	67.38	32.62	10.6	9.10	12.78	11.44
DCh 19/3	61.94	38.06	12.0	10.33	11.92	8.80

Starting with the first decade of July, the field was attacked by pathogens *Alternaria porri*, f. sp. *solani* Neerg. *and Fusarium oxysporum* f.

sp. *sweet potato.* The intensity, frequency and degree of attack (%) with which *Alternaria porri,* f. sp. *solani* Neerg manifested itself in the experimental field between the years 2020-2022 (Table 6) showed the resistance of some genotypes to the disease, respectively DK 19/4 and DCh 19/3.

Table 6. Degree of attack (%) of *Alternaria porri,* f. sp. *solani* Neerg between 2020-2022

Variant	FA (%) for years			Degree of attack (%)		
	2020	2021	2022	2020	2021	2022
KSP1	26.67	23.33	23.33	7.17	8.50	11.6
KSC 1	20.00	13.33	30.00	9.17	7.50	13.1
YULMI	26.67	16.67	23.33	13.33	9.17	12.5
JUHWANGMI	33.33	26.67	33.33	14.50	11.1	15.3
HAYANMI	23.33	13.33	23.33	9.83	5.33	11.1
DK 19/5	33.33	30.00	30.00	15.83	15.0	15.0
DK 19/4	20.00	20.00	30.00	7.70	9.27	8.93
DK 19/1	36.67	36.67	30.00	15.93	14.3	13.3
DK 19/2	26.67	23.33	20.00	11.27	8.27	9.50
DCh 19/3	10.00	13.33	20.00	5.83	6.67	9.50

Frequency and degree of attack (%) with which *Fusarium oxysporum* f. sp. *sweet potato* manifested itself in the experimental field between the years 2020-2022 (Table 7) showed the susceptibility of some genotypes to the disease, respectively DK 19/1 and JUHWANGMI.

Table 7. Degree of attack (%) of *Fusarium* oxysporum f. sp. *sweet potato* beetween 2020-2022

Variant	FA (%) for years			Degree of attack (%)		
	2020	2021	2022	2020	2021	2022
KSP1	23.33	16.67	16.67	8.67	7.83	7.00
KSC 1	13.33	20.00	26.67	6.67	8.33	9.00
YULMI	20.00	16.67	20.00	9.17	8.33	9.17
JUHWANGMI	33.33	26.67	30.00	14.00	10.6	11.5
HAYANMI	20.00	16.67	16.67	7.33	7.00	7.00
DK 19/5	30.00	26.67	26.67	12.83	12.8	10.4
DK 19/4	20.00	23.33	26.67	7.83	9.50	8.50
DK 19/1	33.33	26.67	30.00	14.00	12.5	14.1
DK 19/2	16.67	16.67	16.67	10.00	8.33	7.50
DCh 19/3	13.33	13.33	10.00	5.00	5.83	5.00

CONCLUSIONS

The climatic conditions during the sweet potato vegetation period, recorded during the years 2020-2022 (high temperatures during the period of formation and accumulation of tubers, as well as drought conditions) were beneficial to the accumulation of assimilates in the tubers.
The studied cultivars accumulated an amount of solube dry matter (SDM) between 27% for the JUHWANGMI cultivar and 46.98% for the HAYANMI cultivar, with an average of the cultivars of 35.35%.

The analysis of variance on the yield obtained in the sweet potato genotypes revealed a significant difference for JUHWANGMI, DK 19/1 and DK 19/4 compared to the average yield (31.838 to/ha).
In the field, the ten genotypes had a shoot growth rate ranging from 1.57 cm/day in the DK 19/5 line to 2.71 cm/day in the KSC 1 variety.
Susceptibility to the two diseases in the experimental field between the years 2020-2022, showed the DK 19/5, DK 19/1 and JUHWANGMI genotypes, while the DCh 19/3 genotype showed some resistance.

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