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PRELIMINARY STUDIES ON THE PRODUCTION OBTAINED DEPENDING ON THE IRRIGATION RATE APPLIED TO SWEET POTATO CROP IN SOUTHERN OLTENIA

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ABSTRACT

This scientific paper presents the results of a study carried out at Dăbuleni Research-Development Station for Plant Culture on Sands in 2024, regarding the production obtained at sweet potato plants grown in Southwest Romania, on sandy soils and in different irrigation regimes. The average productions obtained by the four varieties depending on the irrigation variant showed the productive potential of the Koretta variety, which achieved statistically assured productions as very significant in two of the three variants, respectively in V 1 (production increase of 30.64 t/ha compared to the control variety Dabu 23) and in V 2 (production increase of 23.96 t/ha).

INTRODUCTION

Soil moisture appears to be the most limiting factor in determining the number of storage roots during the critical early developmental stages, from one to 30 days after transplanting (SMITH and VILLORDON, 2009). Sweet potatoes are believed to be a – at least moderately – drought-tolerant crop that responds very well to irrigation, even when water is naturally available (RASHID, 1989; DAF, 2011; THOMPSON, 2014). Drought stress reduces nitrogen compounds and root yield, while increasing root dry matter, the latter being the best indicator and selection criterion for drought tolerance (EKANAYAKE and COLLINS, 2004). If irrigated at transplanting and for the first 40 days on demand, plants can be expected to survive subsequent water stress. In fact, irregular watering (too little or too much water) causes reductions in yield and quality: uneven water availability causes growth cracks, and drought can reduce yields. Excess water in extremely wet soils causes problems due to lack of oxygen.

In saturated soils, lenticels expand, and if wet conditions persist, roots rot (URL 3; URL 1). Irrigation of sweet potatoes beyond 60 % of field capacity has been considered uneconomical (NAIR et al., 1989). Recommendations for irrigation regimes vary. Irrigation is recommended when 40 to 50 % of field capacity moisture has been depleted (URL 3). Under dry conditions, 2.5 cm of water should be provided weekly for up to 2 weeks before harvest (URL 2). The first 5–6 weeks are most critical, and drought-affected periods, however, should not be irrigated between the 40th and 60th days. Similarly, withholding irrigation for 5 days in the last week of July is recommended to

promote the development of storage roots under drought stress (URL 4). Too much water should not be applied at once to avoid cracking of the tubers, and irrigation should be stopped in the last 1-1.5 months before harvest (URL 5; URL 3). According to Clemson (URL 3), on the other hand, a constant supply of water, especially during the tuber formation stage at 7 to 9 weeks, is considered important. In Spain, three or four irrigations have been found to be sufficient throughout the growing season. In extremely dry conditions, however, eight to nine irrigations every fifteen days are recommended (URL 6). In general, 18 to 20 mm of water per week can be applied at the beginning of the season and 40 to 45 mm per week in the middle of the season, when the storage roots are rapidly growing, and a reduction to about 20 mm at the end of the season (DAFF, 2011).

Various irrigation systems can be effectively applied to sweet potato, depending on the current climatic and soil conditions, as well as the genotype, among others. Overhead irrigation systems (pivot or linear, pipe and column or a lateral rolling system), drip and furrow irrigation are the most commonly used systems (BRANDENBERGER et al., 2014). Drip irrigation has been found to be more water-efficient compared to sprinkler irrigation (KUEPPER, 2014). On the other hand, it resulted in a higher yield compared to closed furrow systems, although it showed a higher water use efficiency (ÖNDER et al., 2015).

MATERIAL AND METHODS

The research was carried out in 2024 at the Dabuleni Research Development Station for Plant Culture on Sands on the sweet potato culture studied within a bifactorial experience placed in the field according to the method of subdivided parcels with 2 factors. The study factors were:

- **A**. **Variety**:
  - a 1- Koretta
  - a 2- Hayanmi
  - a 3- Ro-Ch-M
  - a 4- Dabu 23
- **B. The amount of water applied through irrigation during the growing season**:
  - b_1- 250 m³ water/ha, applied once every 3 days x 37 irrigations = 9250 m³ water/ha
  - b_2- 250 m³ water/ha, applied once every 5 days x 24 irrigations = 6000 m³ water/ha
  - b_3- 250 m³ water/ha, applied once every 7 days x 19 irrigations = 4750 m³ water/ha

The water consumption (mc/ha) was recorded on May 20, with the seedlings being planted on May 10. By the end of the growing season, 37 waterings were applied at V 1, 24 waterings at V 2 and 19 waterings at V 3.

Added to these irrigation norms is the amount of precipitation that fell during the growing season of sweet potato, from May 10, 2024, namely 1182 mc/ha (35 mm in May, 22.6 mm in June, 22.6 mm in July, 1.4 mm in August, 30.0 mm in September, 6.6 mm in October).

In the climatic conditions of Romania, the sweet potato is propagated vegetatively, by shoots obtained in a double-walled greenhouse. The substrate for planting was made up of a mixture of black soil, sand and peat, in equal proportions. About 50 days after planting, the shoots obtained in the greenhouse were harvested and transplanted in the experimental field according to the technology of cultivating

sweet potatoes on sandy soils. The shoots were planted at a distance of 90 cm between rows and 25-30 cm between plants per row, the land having previously been shaped, mulched with black polyethylene film, under which the drip irrigation system was installed (Diaconu și colab., 2018, Diaconu și colab. 2024).

RESULTS AND DISCUSSIONS

The Dabuleni Research Development Station for Plant Culture on Sands is located in the vast area of sandy soils (>100,000 ha) located in the southern part of Oltenia, and in the current climatic conditions, generated by the changes that have occurred at the global level, the thermal regime of the air in this area has an increasing tendency, especially in the summer months, when the phenomenon of heat often sets in. The experiment was located on a sandy soil, with a nitrogen content that varied between 0.02 % and 0.04 %, with averages being below 0.03 %, which means that the soil nitrogen supply status was reduced (table 1).

Table 1

Soil fertility status in the sweet potato irrigation experiment

Variant	Depth (cm)	Nt (%)	Extractable phosphorus (ppm)	Exchangeable potassium (ppm)	Organic carbon (%)	Humus %	pH
V1	0-25	0.04	71.91	76.8	0.51	0.87	7.99
	25-50	0.03	63.94	51.2	0.63	1.08	8.09
Average		**0.04**	**67.93**	**64**	**0.57**	**0.98**	**8.04**
V2	0-25	0.03	83.2	38.4	0.02	0.03	8.04
	25-50	0.02	73.24	25.6	0.02	0.03	8.05
Average		**0.03**	**78.22**	**32**	**0.02**	**0.03**	**8.05**
V3	0-25	0.03	62.84	44.8	0.07	0.12	8.02
	25-50	0.02	65.94	51.2	0.18	0.03	8.06
Average		**0.03**	**70.18**	**48**	**0.24**	**0.36**	**8.04**
Soil fertility status		**Low**	**Normal**	**Low**	**Low**	**Low**	**Alkaline**

The extractable phosphorus content ranged from 62.8 ppm to 78.22 ppm. with an average of 70.18. indicating a normal soil supply status in extractable phosphorus.

The soil supply status with exchangeable potassium ranged from 25.6 ppm to 76.8 ppm. with averages below 48 ppm. indicating a reduced supply.

The unevenness of the soil could also be observed from the results obtained for organic carbon. It ranged from 0.02 – 0.63 %. with an average of 0.24 %. for the first variant having an average of 0.57 %. indicating a reduced fertility status. and for the second and third variants. the averages were 0.3 % – 0.14 %. also indicating a reduced supply status.

The pH ranged between 7.99 – 8.06, indicating a weak alkaline pH. Water has a very well-defined role in plant metabolism, but the amount applied through irrigation if it exceeds the needs of the plants can lead to an extension of the vegetation period, incomplete maturity of the tubers with changes in their biochemical composition.

From a climatic point of view, the year 2024 was characterized by average temperatures ranging between 0.5 °C in January and 26.5 °C in July, exceeding the multiannual average temperature (1956 – 2024) by 2.46 °C. This year, the lowest temperature was recorded in January. being -12.9 °C, and the highest temperature was recorded in July, at 40.97 °C. Correlated with the lack of precipitation during the

tuber accumulation period (August. 1.4 mm). the extremely high temperature in July and August, with maximums of 40.32 °C in August and 40.97 °C in July, negatively influenced the development of the plants. These high temperature values blocked the physiological processes and thus the formation and thickening of the roots was difficult. the plant requiring additional irrigation by sprinkling. in addition to irrigation through the drip network. once every two days. During the vegetation period of the sweet potato plant. the highest value of precipitation was recorded in May (114 mm), when planting the shoots, while the lowest value was recorded in August. with 1.4 mm distributed over 2 days, their annual amount being 74.1 mm lower than the multiannual monthly amount (1956-2023) (table 2).

During the sweet potato growing season. corresponding to May-October, the average air temperature ranged from 12.5 °C in October to 26.54 °C in July. while the minimum temperature was 0 °C during the harvest period and -2.97 °C (in the third decade. after harvesting the tubers) in October. Absolute maximum temperatures of 40.32 °C and 40.97 °C were recorded in August and July. respectively, and the amount of precipitation was 1.4 mm in August. In terms of humidity, sweet potato plants have moderate requirements, higher when depositing reserve substances in the roots, when they require 70-80 % of the field capacity for water. The crop grows well in areas that record about 750 – 1000 mm of precipitation annually, with a minimum of 500 mm during the growing season. The crop is sensitive to drought during the tuber initiation stage (50 – 60 days after planting) and is not tolerant of water stagnation, as this can cause tuber rot and reduce root growth due to poor aeration. Lack of water causes a decrease in production and starch content of roots. For sweet potatoes, drought represents an annual yield loss of 25 % compared to a yield loss of more than 50 % or total failure of staple crops such as maize. Despite this advantage. its importance as a food security crop is still underestimated and does not attract sufficient attention from agricultural researchers.

Table 2

Main climate data for the agricultural year 2024

Climatic element	***V***	***VI***	***VII***	***VIII***	***IX***	***X***
Average temperature (ºC)	16.7	25.05	26.54	25.87	19.28	12.53
Maximum temperature (ºC)	28.6	37.92	40.97	40.32	33.13	29.55
Minimum temperature (ºC)	7.4	11.34	10.25	10.51	4.26	-2.97
Relative air humidity (%)	71.1	61.46	56.33	52.94	65.53	78.17
Rainfall amunt mm	114	22.6	22.6	1.4	30	6.6
Number of days with rain	15	6	5	2	6	2
Multiannual average temperature (1956-2023). (°C)	16.94	21.59	23.36	22.74	18.00	11.57
Multiannual monthly average of rainfall (1956-2023). (mm)	63.41	69.35	53.82	36.03	44.73	42.47

The average watering rate ranged between 235 mc/ha and 246 mc/ha, the difference between these being given by technical factors (type of motor pump Rotak or Honda. operating hours. etc.). The first harvest of tubers was made on August 26, 100 days after planting the shoots in the field. On this date, high yields were obtained for the Koretta variety, in V 1 (48.53 t/ha), as well as in the second harvest (46.27 t/ha) and following the harvest at 120 days, carried out on September 23, the average yield obtained for the Koretta variety at V1 was 75.47 t/ha. (Figure 1).

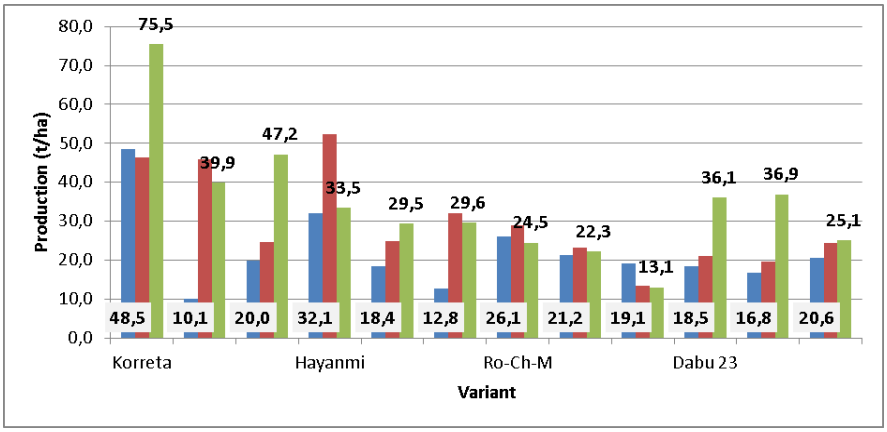

Figure 1. Representation of the production obtained according to the irrigation options

From the analysis of the production obtained at the final harvest of sweet potato, the Koretta variety obtained statistically significant productions compared to the control variety Dabu 23 (with a production increase of 21.48 t/ha). The differences of 4.43 t/ha (at Hayanmi) and 6.60 t/ha at Ro-Ch-M were not statistically significant (table 3).

Table 3

The influence of variety on tuber production

Variety	Average production (t/ha)	Difference from the control (t/ha)	Difference from the control (%)	Semnification
Koretta	46.01	21.48	187.5	***
Hayanmi	28.97	4.43	118.1	
Ro-Ch-M	31.14	6.60	126.9	
Dabu 23	24.54	Mt	Mt (100)	

LSD 5 %=7.0 t/ha
LSD 1 %=10.5 t/ha
LSD 0.1 %=16.9 t/ha

The irrigation variant also influenced the production obtained, the difference being statistically ensured as distinctly significant in the case of V 2 (5760 mc/ha) and very significant in the case of irrigation variant V 1 (table 4).

Table 4

The influence of irrigation variant on tuber production

Varianta de irigare	Average production (t/ha)	Difference from the control (t/ha)	Difference from the control (%)	Semnification
V 1	39.4	13.85	154.2	**
V 2	33.0	7.4	128.9	
V 3	25.58	Mt	Mt (100)	

LSD 5 %=5.1 t/ha
LSD 1 %=7.0 t/ha
LSD 0.1 %=9.7 t/ha

The average yields obtained by the four varieties depending on the irrigation variant showed the productive potential of the Koretta variety. which achieved statistically significant yields in two of the three variants, respectively in V 1 (production increase of 30.64 t/ha compared to the control variety Dabu 23) and in V 2 (production increase of 23.96 t/ha) (Figure 2).

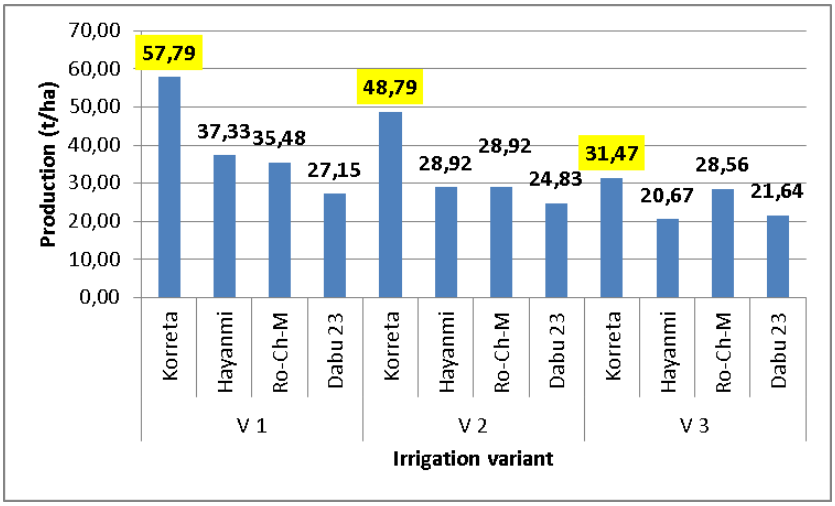

Figure 2. Representation of production obtained according to variety and irrigation options

A distinctly significant positive correlation (r=0.8579) was established between the production obtained at harvest by variant and the irrigation rate applied. which shows that production increases with the increase in the irrigation rate applied to the crop (Figure 3).

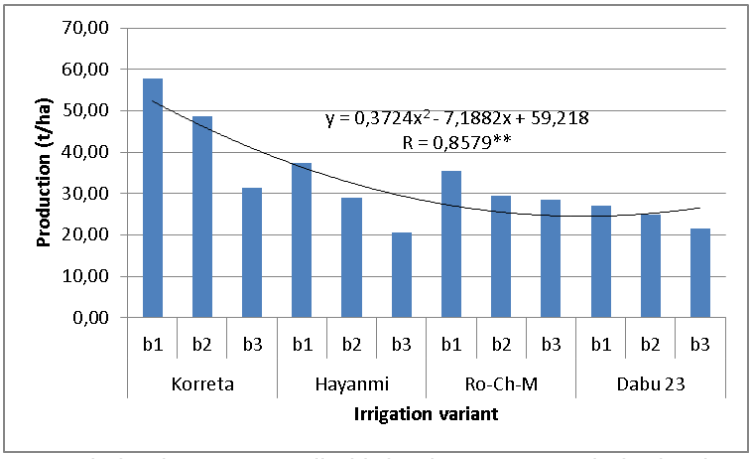

Figure 3. Correlation between applied irrigation norms and obtained production

Regarding the supply status of tubers with soluble dry matter, Ro-Ch-M was noted in the V 2 variant. with a SUS content of 12.2 %. The highest starch content

was in the Koretta variety, at V 3 (16.97 %). and in vitamin C in Dabu 23 at V 1 and V 3. the value being 10.56 mg/100 g d.p.. but also in Korreta at V 2 (table 5).
The average value of biochemical compounds for the 4 genotypes and three irrigation norms was 74.7 % water. 25.3 % SUT. 11.0 % SUS. 12.7 % starch and 9.5 mg/100 g d.p. vitamin C.

Table 5

Biochemical composition of sweet potato tubers

Variant	Water (%)	Total dry matter (%)	Soluble dry matter (%)	Starch (%)	Vitamin C (mg/100 g f.s.)
Korreta V 1	79.77	20.23	9.8	13.55	9.68
Korreta V 2	68.88	31.12	10	10.48	10.56
Korreta V 3	76.7	23.3	10.2	16.97	9.68
Hayanmi V 1	71.68	28.32	10.4	12.67	9.68
Hayanmi V 2	71.14	28.86	11	10.90	8.8
Hayanmi V3	81.8	18.2	10.2	11.28	9.68
Ro-Ch-M V 1	77.43	22.57	12	13.36	8.8
Ro-Ch-M V 2	71.89	28.11	12.2	11.90	7.92
Ro-Ch-M V 3	82.03	17.97	11.8	15.85	8.8
Dabu V 1	72.8	27.2	11.6	11.65	10.56
Dabu V 2	69.35	30.65	11.8	12.51	9.68
Dabu V 3	72.94	27.06	11	11.65	10.56
Average	**74.7**	**25.3**	**11.0**	**12.7**	**9.5**

CONCLUSIONS

- A distinctly significant positive correlation was established between the production obtained at harvest by variant and the irrigation rate applied (r=0.8579). which shows that production increases with the increase in the irrigation rate applied to the crop.

- The average productions obtained by the four varieties depending on the irrigation variant showed the productive potential of the Koretta variety. which achieved statistically assured productions as very significant in two of the three variants, respectively in V 1 (production increase of 30.64 t/ha compared to the control variety Dabu 23) and in V 2 (production increase of 23.96 t/ha).

- Regarding the supply status of tubers with soluble dry matter, Ro-Ch-M was noted in the V 2 variant. with a SUS content of 12.2 %. The highest starch content was in the Koretta variety, in V 3 (16.97 %). and in vitamin C in Dabu 23 in V 1 and V 3. the value being 10.56 mg/100 g d.p. but also in Korreta in V 2.

- From the analysis of the production obtained at the final harvest of the sweet potato. the Koretta variety obtained statistically assured productions as very significant compared to the control variety Dabu 23 (with a production increase of 21.48 t/ha).

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