Analele Universităţii din Craiova, seria Agricultură – Montanologie – Cadastru (Annals of the University of Craiova - Agriculture, Montanology, Cadastre Series) Vol. XLIX/2019

THE BEHAVIOR OF VARIETIES OF JERUSALEM ARTICHOKE ON THE SANDY SOILS FROM SOUTH OF OLTENIA

CIUCIUC ELENA, DRĂGHICI IULIAN, DRĂGHICI RETA, CROITORU MIHAELA, BĂJENARU MARIA FLORENTINA

Keywords: jerusalem artichoke, variety, sandy soils

ABSTRACT

The Jerusalem artichoke (Helianthus tuberosus) is considered a species with relatively high tolerance to water stress and very high adaptability to extremes of unfavorable factors - drought resistance, at extremely high temperatures (35^0- 45^0C the plants and -30^0 -45^0C the tubers). The tubers with high inulin content are formed on the root branches and are increasingly used as food for patients with diabetes. The variety is one of the main factors of the technology, the cultivation of a variety should be done only after a preliminary test regarding its adaptability to the natural environmental factors. On the sandy soils from Dabuleni were studied the varieties Dacic, Olimp, Rustic and the local population Dăbuleni. It was noted by the number of tubers/plant the Olimp variety with 60.4 stems/plant, and the highest weight of a tuber was recorded in the Rustic variety (51.6 g/tuber). The highest production was made at the Olimp variety, respectively 70.03 t/ha, corresponding to the largest number of tubers harvested at a plant, followed by the production of the Rustic variety of 51.97t/ ha. At the Dacic variety, 15.6 t/ha were obtained, and the local population of Dăbuleni achieved the lowest production (6.45 t/ha). The inulin content was between 12.49% in the Rustic variety and 14.47% in the Olimp variety. Dacic varieties and local population Dăbuleni were highlighted by high in total dry matter, soluble dry matter and soluble carbohydrates, and Rustic varieties and local population Dabuleni were high in vitamin C content (14.92-14.96 mg).

INTRODUCTION

The Jerusalem artichoke (*Helianthus tuberosus*) is a perennial plant that has a grassy stem that can reach a height of 3 m, the vegetative part of the plant drying in the fall. Due to the large strains, it can be successfully used to make protective curtains to protect crops more sensitive to cold winds or to prevent the evaporation of moisture from the soil. The root of the plant is a rhizome. On the root branches the of the tubers are formed onwhich were used in food or especially for animal feed.

The Jerusalem artichoke is one of the richest inulin-rich plants (Saengthongpinit W et al., 2005; Rodriquez M.A., et al., 2005), a high-fructose carbohydrate, which gives it a pleasant sweet taste. Due to its inulin content, it has become increasingly used as food for patients with diabetes, the administration of Jerusalem artichoke leads to a lowering of blood sugar, but also to its stabilization, lowers cholesterol, regulates blood pressure, prevents heart disease, stimulates immunity, treats candidiasis digestive, treats constipation, prevents colon cancer, reduces joint pain, prevents osteoporosis due to its high calcium content but also due to the ability to promote the assimilation of this mineral from other food sources: dairy, nuts, soy, broccoli, green leafy vegetables.

It has a high nutritional value due to the presence of almost all essential amino acids (Rakhimov et al., 2003), is used as feed in animal feed (Seiler and Campbell. 2004), and biomass is considered as a rich source of ethanol (Denoroy P 1996). The biogas production

in the Jerusalem artichoke is much higher compared to other energy crops (Emmerling, C., 2007).

The Jerusalem artichoke is considered drought resistant and can be cultivated at low costs without irrigation, exploiting the poor soils (Monti A et al., 2005), shows very high adaptability to the extremes of the unfavorable factors - drought resistance, at extremely high temperatures (35^0-45^0 C plants and -30^0 - 45 C tubers), resistance to high concentrations of salts, heavy metals, nitrates.

The variety is one of the main factors of the technology, the cultivation of a variety should be done only after a preliminary test regarding its adaptability to the natural environmental factors.

Research by Qiwen Zhong et al., 2018, has revealed a relationship between genotypes and the geographical origin of the Jerusalem artichoke variety. The production of tubers, the number of tubers per plant and the size of tubers at the topinambur are influenced by genetic. The production of tubers, the number of tubers and the size of the tubers depend on the interaction of the variety with the environmental factors. Between the size of the tubers and the number of tubers there is a negative correlation (the increased size of the tubers is detrimental to the number of tubers) (Primsaen W.and all., 1010). Through the experiences performed at Research-Development Sation for Plants Crops on on Sandys Soils Dabuleni, we have proposed to test some native varieties of Jerusalem artichoke, in the conditions of sandy soils in order to recommend for the culture those that have high adaptability to the specific climatic conditions of the area materialized by the level of productions and its quality.

MATERIAL AND METHOD

The varieties *Dacic, Olimp, Rustic* and the L*ocal population of Dăbuleni* were studied. The experience is monofactorial and was placed according to the method of randomized blocks in three repetitions. Field planting of tubers was done manually between April 1-10. In each variant, three rows were planted using a distance of 0.7 m between rows and 40 cm between plants per row. Observations and determinations were made concerning: the height of the plant, the diameter of the stem, the average number of tubers/plant, the average weight of a tuber, the production of tubers and its quality. The tubers were harvested on October 31

RESULTS AND DISCUSSIONS

Regarding the biometric determinations, each determined element had different values, specific to each variety studied (table 1).

Table 1

Biometric determinations in Jerusalem artichoke varieties

The variety	The height of the plant (cm)	Stem diameter (mm)	Biomass production (t/ha)
Dacic	60.2	26.81	29.9
Olimp	284.0	24.72	73.3
Rustic	302.4	23.11	70.5
Local population	267.8	24.05	69.9

The height of the plants was between 60.2 - 302.4 cm. The variety, *Dacic* being a dwarf variety had an average height of 60.2 cm, and the other high waist varieties presented heights of 267.8 cm the local population Dăbuleni, 284 cm *Olimp* variety and 302.4 cm *Rustic* variety. The diameter of the strain was close in value at the four varieties being between 23.11 mm in the Rustic variety and 29.81 mm in the *Dacic* variety.

The lowest biomass production was recorded in the *Dacic* variety (29.9 t/ha), followed by the *local population* Dăbuleni with biomass production of 69.9 t / ha, the *Rustic* variety with 70.5 t/ha and the *Olimp* variety with 73.3 t/ha.

The number of tubers harvested at one plant fluctuated to a very large extent depending on the variety studied. The smallest number of tubers was harvested at the population of Dăbuleni, respectively 10 tubers/plant (table 2).

Table 2

Influence of the variety on the number of tubers / plant

The variety	Number of tubers/plant	Relative number of tubers/plant %	Difference (number of tubers/plant)	Significance
Dacic	44.8	123	+9.5	
Olimp	60.4	166	+24.1	*
Rustic	30.0	83	-6.3	
Local population	10.0	28	-26.3	0
Average of varietyes	**36.3**	**100**	**Mt**	**Mt.**

LSD 5% = 19,184 tubers/plant
LSD 1% = 26,928 tubers/plant
LSD 0,1% = 38,016 tubers/plant

In the *Rustic* variety, 30 tubers/plant were harvested, at the *Dacic* variety 44.8 tubers/plant, and at the *Olimp* variety 60.4 tubers/plant were harvested. Compared to the average of the varieties, the number of tubers / plant was exceeded by the *Olimp* variety and the *Dacic* variety, the differences being statistically insured as significant in the positive sense to the *Olimp* variety and significant in the negative sense to the *local population* Dăbuleni.

Regarding the average weight of a tuber, there are very large differences between the studied varieties. The *Dacic* variety had the smallest tubers, the average weight of a tuber being 15.6 g, followed by the *local population* Dăbuleni with a tuber weight of 17.2 g (table 3).

Table 3

The influence of the variety on the average weight of a tuber

The variety	The average weight of a tuber		Difference (g/ tuber)	Significance
	g/ tubercul	%		
Dacic	15.6	53	-13.6	0
Olimp	32.4	111	+3.2	
Rustic	51.6	177	+22.4	**
Local population Dăbuleni	17.2	59	-12.0	0
Average of varietyes	**29,2**	**100**	**Mt.**	**Mt.**

LSD 5% = 11,968 g/tuber
LSD 1% = 16,799 g/tuber
LSD 0,1% = 23,716 g/tuber

At the *Olimp* variety, a tuber weighed on average 32.4 g, and in the *Rustic* variety the largest tubers were obtained, with an average weight of 51.6 g/tuber. The average of varietyes with regard to the average weight of a tuber was exceeded by the *Rustic* variety and the *Olimp* variety. The production differences were insignificant for the *Olimp* variety and distinctly significant for the *Rustic* variety. The differences of the Dacic variety and of the *local population*

of Dabuleni were significant in a negative sense compared to the average of the varieties. The number of tubers/plant and their weight determined the production of tubers per plant and implicitly the production per hectare.

All these elements of productivity analyzed previously determined the production of tubercles at the Jerusalem artichoke per hectare (table 4). The highest production was made at the *Olimp* variety, respectively 70.03 t/ha, corresponding to the largest number of tubers harvested at a plant, followed by the production of the *Rustic* variety of 51.97t/ ha. At the Dacic variety, 15.6 t/ha were obtained, and the *local population* of Dăbuleni achieved the lowest production of 6.45 t/ha.

Table 4

The influence of the variety on the production of tubers

The variety	The production		Difference (t/ha)	Significance
	t/ha	%		
Dacic	15.60	43	-20.41	0
Olimp	70.03	194	+34.02	**
Rustic	51.97	144	+15.96	
Local population Dăbuleni	6.45	18	-29.56	**0**
Average of varietyes	**36,01**	**100**	**Mt.**	**Mt.**

LSD 5% = 19,916 t/ha
LSD 1% = 30,158 t/ha
LSD 0,1% = 48,448 t/ha

Compared to the average of the varieties, the production increase achieved by the *Olimp* variety was statistically significant, and the production differences realized by the *Dacic* variety and the *local population* of Dăbuleni were significantly negative compared to the average of the varieties. The *Olimp* variety was noted by both the number of tubers/plant and the production of tubers/plant and the production per hectare. *Rustic* variety was noted by the average weight of a tuber.

The value of the Jerusalem artichoke as a fodder crop, of a technical and medical vegetable is based primarily on the chemical composition of the plant.

In order to determine the quality of the Jerusalem artichoke tubers, samples were taken at the technological maturity, and the following determinations were made in the laboratory: water content and total dry matter, soluble vitamin C and inulin. The varieties taken into the study accumulated in the tubers an amount of total dry matter between 21.23% in the *Olimp* variety and 28.45% in the *Dacic* variety, with an average of 24.79% varieties (table 5). The highest content of total dry matter was determined in the *local population* (26.68%) and in the *Dacic* variety (28.45%).

Sandra Žaldarienė et al., 2012, showed that the Jerusalem artichoke contains a sufficiently large amount of dry matter between 19.26% and 23.21%, so values similar to those obtained on the sandy soils of southern Oltenia. Similar data was obtained by Dzabiev, 2003 (an average of about 22.0%).

The amount of water from the Jerusalem artichoke tubers was between 71.55% in the *Rustic* variety and 78.77% in the *Olimp* variety, with an average of 75.21%. A greater amount of water was obtained by Sorina Ropciuc et al., 2014, (82.4%). The amount of soluble dry matter, determined refractometrically, was between 20.4% in the *Olimp* variety and 25.2% in the *local population*, with an average of 22.95%.

Table 5

Biochemical composition of topinambur tubercles depending on the variety studied

The variety	Total dry matter (%)	The water (%)	Soluble dry matter (%)	Carbo-hydrates (%)	Inulin (%)	Vitamin C (mg/100 g f.s.)
Dacic	28.45	71.55	25.0	20.80	13.45	11.44
Olimp	21.23	78.77	20.4	16.90	14.47	12.32
Rustic	22.79	77.21	21.2	17.62	13.71	14.92
Local population	26.68	73.32	25.2	21.17	12.49	14.96
Average of varietyes	**24.79**	**75.21**	**22.95**	**19.12**	**13.53**	**13.42**

The carbohydrate content of the Jerusalem artichoke tubers showed very high values (16.90% in the Rustic variety and 21.17% in the local population, with an average of 19.12%. The soluble carbohydrates besides inulin are its fructooligosaccharide derivatives, simple sugars. (fructose and glucose) and sucrose.

The inulin content was between 13.45% in the Rustic variety and 14.47% in the Olimp variety, with an average of 13.53%. Similar results were obtained by Wei Lingyun et al, 2007, in a study conducted in northern China (14-18%). Also J. Brkljača et al., 2014, found that the inulin content of the Jerusalem artichoke tubercles varies between 8.16 and 13.46% of the fresh weight.

The vitamin C content of Jerusalem artichoke tubers showed values between 11.44 mg in the Dacic variety and 14.96 mg in the local population, with an average of 13.42 mg. The literature indicates at Jerusalem artichoke an average vitamin C content of 4 mg/100g fresh substance.

The vitamin C content of Jerusalem artichoke tubers showed values between 11.44 mg in the Dacic variety and 14.96 mg in the local population, with an average of 13.42 mg. The literature indicates at Jerusalem artichoke an average vitamin C content of 4 mg/100g fresh substance.

COCLUSIONS

The number of tubers / plant and the average weight of a tuber determined the level of production achieved at the surface unit.

It was noted by the number of tubers / plant and the production the *Olimp* variety, and by the average weight of a tuber the *Rustic* variety was remarqed.

The Jerusalem artichoke behaved very well from a qualitative point of view, under the conditions of sandy soils. The *Dacic* varietye and *local population* Dăbuleni were high in total dry matter, soluble dry matter and soluble carbohydrates, and *Rustic* varieties and *local population* were high in vitamin C (14.92-14.96 mg).

ACKNOWLEDGMENT

This work was supported by a grant of the Romanian Ministery of Research and Innovation CCDI - UEFISCDI, *"Complex system of integral capitalization of agricultural species with energy and food potentia*l", project number PN-III-P1-1.2-PCCDI-2017-0566, Contract no. 9PCCDI / 2018, within PNCDI III.

BIBLIOGRAPHY

J. Brkljača, M. Bodroža-Solarov, J. Krulj, S. Terzić, A. Mikić, A. Marjanović Jeromela, *2014* -

*Quantification of Inulin Content in Selected Accessions of Jerusalem Artichoke (*Helianthus tuberosus *L.), Helia, Volume 37, Issue 60, Pages 105–112.*

Denoroy P., 1996. *The crop physiology of Helianthus tuberosus L.: a model oriented view.* Biomass Bioenerg 11(1), 11-32.

Dzabiev T. T. - 2003. *Efektivnost' ispol"zovaniya topinambura sorta Skorospelka pri vyrashchivashchivanii molodnyaka sviney: disertatsiya*. Vladikavkaz. 158 c

Emmerling, C., Barton, J., 2007 - *Anaerobic co-digestion of topinambour (Helianthus tuberosus L.) and properties of the remaining biogas manure*, Archives of Agronomy and Soil Science, Volume 53, Number 6, December 2007 , pp. 683-690(8).

Monti A., Amaducci M.T., Venturi G., 2005. *Growth response and leaf gas exchange and fructans accumulation of Jerusalem artichoke (Helianthus tuberosus L.) as affected by different water regimes.* Eur J Agron 23, 136-145.

Primsaen W., S. Jogloy, B. Suriharm, T. Kesmala, V. Pensuk and A. Pantanothai, 2010 – *Genotype by Environment (GxE) Interaction for Yield Components of Jerusalem Artichoke (Helianthus tuberosus L.).* Asian Journal of Plant Sciences, vol. 9, pp 11-19. https://sciarlet.net/abstract/?doi=ayps.2010.11.19.

Rakhimov D.A., Arifkhodzhaev A.O., Mezhlumyan L.G., Yuldashev O.M., ROZIKOVA U.A., Aikhodzhaeva N., Vakil M.M., 2003. *Carbohydrates and proteins from Helianthus tuberosus.* Chem Nat Comp 39(3), 312-313.

Rodrigues M.A., Coutinho J., Martins F., Arrobas M., 2005. *Quantitative sidedress nitrogen recommendations for potatoes based upon crop nutritional indices.* Eur J Agron 23(1), 79-88.

Ropciuc Sorina, Sonia Amariei, Ana Leahu, Cristina Damian, Iuliana Cretescu, 2014 - *Study on Exploitation of Jerusalem Artichoke Bulbs in Relation to Chemical Composition*, Scientific Papers: Animal Science and Biotechnologies, 2014, 47 (2).

Saengthongpinit W., Sajjaanantakul T., 2005*. Influence of harvest time and forage temperature on characteristics of inulin from Jerusalem artichoke (Helianthus tuberosus L.) tubers.* Postharvest Biol Technol 37, 93-100.

Sandra Žaldarienė, Jurgita Kulaitienė, Judita Černiauskien, 2012 - *The quality comparison of different Jerusalem artichoke (Helianthus tuberosus L.) cultivars tubers, ŽEMĖS ŪKIO MOKSLAI.* 2012. T. 19. Nr. 4. P. 268–272 © Lietuvos mokslų akademija,

Seiler G.J., Campbell L.G., 2004. *Genetic variability for mineral element concentrations of wild Jerusalem artichoke forage*. Crop Sci 44, 289-292. Buletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Horticulture. Vol. 73, nr.2.

Qiwen Zhong, Jie Tian, Lihui Wang, Li Li, Mengliang Zhao, Xuemei Sun, 2018 - *Characterization and development of EST-SSR markers to study the genetic diversity and populations analysis of Jerusalem artichoke (Helianthus tuberosus L.).* Genes&Genomix, Volume 40, Issue 10, pp. 1023-1032, octombrie 2018.

Wei Lingyun, Wang Jianhua, Zheng Xiaodong et. Al. , 2007 - *Studies on the extracting technical condition of inulin from Jerusalem artichoke tubers*, Journal of Food Engineering, vol. 79, p. 1087-1093.