

RESULTS REGARDING BIOLOGICAL PARTICULARITIES STUDY OF JERUSALEM ARTICHOKE (*HELIANTHUS TUBEROSUS* L.)

REZULTATE PRIVIND STUDIUL PARTICULARITĂȚILOR BIOLOGICE LA TOPINAMBURUL LEGUMICOL (*HELIANTHUS TUBEROSUS* L.)

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Abstract: This scientific study is based on a research regarding some biological characteristics of the Jerusalem artichoke (*Helianthus tuberosus* L.). The purpose of this research was to evaluate the possibilities to cultivate three of the *Helianthus tuberosus* L. clones (Topstar, Gute Gelbe and Violet de Rennes) in order to evaluate the opportunity to implement a specific cultivation method. The measurements and plant determinations have been taken during the experiment, keeping track of the plant height, the leaf's shape and color, tuber's growth dynamics, tuber's shape and flowering date.

Key words: topinambur, cultivation method, plant height, leaf shape and color, tuber growth dynamic, tuber shape, flowering date.

Rezumat. Lucrarea constă într-un studiu privind unele particularități biologice ale speciei legumicole topinambur (*Helianthus tuberosus* L.). Scopul cercetărilor a fost de a evalua posibilitățile de cultivare a topinamburului legumicol în vederea evaluării oportunităților de implementare unei tehnologii de cultivare. Materialul biologic a constat din trei clone- Topstar, Gute Gelbe și Violet de Rennes. Pe timpul experimentării au fost efectuate măsurători și determinări asupra principalelor caracteristici: înălțimea plantelor, forma și culoarea frunzelor, dinamica creșterii tuberculilor, forma tuberculilor și data apariției inflorescenței.

Cuvinte cheie: topinambur, tehnologii de cultivare, înălțimea plantelor, forma și culoarea frunzelor, dinamica creșterii tuberculilor, forma tuberculilor, data apariției inflorescenței.

INTRODUCTION

The Jerusalem artichoke species belongs to the *Helianthus* genus, *Asteraceae* family, *Asterales* order, genomic formula $2n = 6x = 102$ (Stanley, 2008). Under cultivation conditions the artichoke behaves as annual species, although in the places of origin and in spontaneous flora it acts as perennial species.

The plant is herbaceous, but in the second period of the yearly life cycle it becomes ligneous at the levels of the main stem and the lower branches (Stanley, 2008).

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The general morphology of the Jerusalem artichoke plant may have a critical impact on productivity. The rapid development and the general architecture of the epigeal part are important advantages for the species' hardiness (Pas'ko, 1973).

The plant morphology is genetically determined and major differences between clones can be distinguished. Two genetically identical plants grown in different conditions may morphologically develop in different ways (Pas'ko, 1973).

The Jerusalem artichoke is cultivated for its tubers, which can be consumed boiled (mostly in soups and other flavored dishes), baked, or even fresh, thanks to their very pleasant taste and nutritional value. The fresh tubers can be cut as thin slices for various types of simple or assorted salads, especially to give the plate a crunchy texture and a slightly nutty taste. It can also be used as canned food, as simple or assorted pickles (Stanley, 2008).

The Jerusalem artichoke species has certain distinctive biochemical properties. The tuber stores the inulin as a reserve substance, in comparison to other species that use the starch as the main source of carbohydrates. The inulin, along the high content of mineral salts, gives the Jerusalem artichoke tubers a high importance in the human diet, especially for people suffering from obesity and diabetes.

The aim of the present research is to conduct a study on the possibilities of cultivating three clones of *Helianthus tuberosus* L. in order to assess the opportunities to implement a base technology.

MATERIAL AND METHOD

The aim of the present research is to conduct a study on the possibilities of cultivating three clones of topinambur in order to assess the opportunities to implement a base technology.

In order to establish the cultivation technology of the *Helianthus tuberosus* L., the following target was set: the study of three clones of the Jerusalem artichoke in comparative cultures.

The Topstar clone has German origin, available in the gene bank from *Leibniz Institut für Pflanzengenetik Kulturpflanzenforschung* (IPK) in Gatersleben, Germany. The average recorded yield is 8 tones of dry matter per hectare (Stolzenburg, 2004).

The Gute Gelbe clone has also German origin, available in the *Research center for special crops*, Austria (under the code WIES-D18). The recorded average yield is 10 tones of dry matter per hectare (Stolzenburg, 2004).

The Violet de Rennes clone is of French origin. The tubers are red-violet, pear-shaped. It matures late, the plant height can reach up to 2-3 m and the plant can form up to two shoots. It is available in the *Leibniz Institut für Pflanzengenetik Kulturpflanzenforschung* (IPK) in Gatersleben, Germany, and *L'Institut National de la Recherche Agronomique* (INRA), France. This variety has been used in numerous studies, mainly as a control crop to compare the new clones. The recorded average yield is 8.8 tones of dry matter per hectare (Fernandez, 1985).

The evaluation of the studied clones was conducted by analyzing the following morphological specifications: plant's height, leaf's shape and color, tuber's shape and the date of inflorescence emergence.

The experience of 2012 was only for guidance purposes because it was conducted at a preliminary stage of the detailed research. It was performed to verify

the previous studies on this species. Since the parcels contain a small number of plants and the variants are not arranged in multiple repetitions and they are not subject to a particular positioning mode, the data cannot be statistically used. The variations are compared between themselves to see whichever is the perspective ones, in order to be thoroughly investigated.

RESULTS AND DISCUSSION

The distribution of plant height

The growth dynamics of Jerusalem artichoke young shoots has been observed since planting (in the first decade of May) until mid-November. The shoots growth rate is different for each clone. While *Topstar* clone, for instance, has a rapid vegetative mass growth, the other two clones are slower. The vegetative mass growth of the early *Topstar* clone decreases from mid-June, when the flowering begins. The other clones, more late, reach the maximum rate of vegetative mass growth exactly in this period. The semi-late or late clones that produce vegetative mass up to October, reach heights that the early varieties achieve only partially.

Table 1

The plants height distribution in centimeters, for each clone

Date	Clone		
	Violet de Rennes	Topstar	Gute Gelbe
9 th of May	28,8	19,3	24,5
18 th of May	51,5	39,0	46,5
14 th of June	171,5	143,3	145,8
19 th of July	290,5	213,0	261,5
7 th of September	398,5	218,0	393,3
16 th of November	417,0	220,0	431,0

The phenotypic characteristics of the leaves

The clear description of Jerusalem artichoke clones can be very difficult due to limited cultivation and permanent replanting of the tubers derived from the crop, so a mix of varieties occurred and, consequently, heterogeneous populations. A sure classification can be usually made only for varieties with a typical appearance.

The propagating material of the present experiment comes from Mr. Georg Lindl from Bavaria, Germany. The tubers were received in small quantities, therefore the subsequent experiments will use the material produced by the first year of cultivation.

For a description of the Jerusalem artichokes varieties used in this experiment, we performed morphological assessments of the leaves. The shape,

size and color of the leaves of the leaves of Jerusalem artichoke clones under study are described as follows:

The *Violet de Rennes* clone

The upper part of young leaves is somewhat wrinkled, the shape is oblong, curved, not very narrow and pointed. The leaves are alternated positioned from the sixth to the eighth typical fully developed leaf.

The leaf's color is fresh strident spring green (light), the young leaves somewhat have a lighter color (almost yellowish green, bright).

The maximum length of the leaf is 17 cm, the maximum width is about 8 cm. The leaf length proportional ratio: leaf width (without petiole) = 1: 0.61.

The edge is serrated for the mature leaves, often forming 1 to 2 peaks in the last third of the leaf (1).

The mature leaf shape is almost round with a sharp end. They have a smooth surface, slightly curved only between the vascular bundles.

The leaf veins are highlighted, the leaf surface is covered with less visible hairs, and the leaf's veins on the inferior part are covered with trichomes.

Leaf tips are bent slightly downward; at the young leaves the laminae are slightly convex.

The large distances between the insertions on the gives a plant elongation impression.

The *Topstar* clone

The young leaf surface is wrinkled between conductive vascular bundles. The mature leaves have a smoother surface, but they partially buckle along the conductive vascular bundles. From the 9th fully growth leaf the arrangement is alternated.

The mature leaf shape is flat in the lower part of the plant, but pointed at the end. The leaves are large; at the top part of the plant the leaves are a little smaller, pointed, oblong, lanceolate.

The maximum length of the leaf is about 20 cm, a maximum width of about 11 cm The leaf length proportional ratio: leaf width (without petiole) = 1: 0.62.

The surface of the mature leaf is slightly hairy (trichomes). The veins on the inferior part of the plant are covered with hairs as well. The leaves are arranged horizontally on the twig.

From the base to the middle section of the plant the leaves are large. In the upper part of the plant, the leaves are smaller and fewer.

The angle between the petiole and young leaves lamina is about 100°-110° (round, downward protruding parts), and for the mature leaves is about 90°-110°.

The *Gute Gelbe* clone

The leaf's surface is much wrinkled, curled, almost silky. They are arranged on the stem from horizontally to vertically. The leaf edge is slightly curved forward. The layout is alternated from the 8th to the 10th leaf.

The mature leaves have a relatively smooth surface with slight convex sides along the conductive vascular bundles, which are however hairy. The leaves are arranged on the stem slightly bent.

The large leaves have a broad lamina, almost round with serrated edge. The leaf shape is similar to the *Topstar* clone, but a bit wider. The coloration is bright to medium green with pale yellow hues at the young stage.

In the lower half of the plant the leaves are especially large. At the top of the plant, they are small and sharp. The angle between the petiole and the lamina is about 90°, approx. right angles convex sides, almost heart-shaped.

The maximum length of the leaf is about 19 cm, a maximum width of about 12 cm. The leaf length proportional ratio: leaf width (without petiole) = 1: 0.69. The petiole is longer.

The date of inflorescence emergence

The studied clones differ widely at the flowering beginning. The Jerusalem artichoke generally falls into the category of short-day plant, so the inflorescence induction occurs after certain daylight duration as a result of phylogenetic adaptation. This is an advantage for the tubers crop and the nutrients content in the storage organs because the photosynthesis and the assimilation capacity is very high due to the high percentage of vegetative mass.

The *Topstar* clone blossoms between the first and the second decade of July, and the other two clones much later, in September.

Table 2

Date of flowering beginning for the studied Jerusalem artichoke clones

Clone	Flowering beginning 2012
Gute Gelbe	18 th of September
Violet de Rennes	12 th of September
Topstar	05 th of July

Tubers' morphological particularities

The tubers of the artichoke varieties often exhibit typical shapes which at harvest can be round, oval, cylindrical, lanceolate or fusiform.

The tubers' number was different depending on the terrain and climate conditions, and in the case of *Topstar* clone side tubers appeared from ramifications at the armpit of the first cataphyll leaves.

Violet de Rennes

The tuber's shape is very inconsistent, oblong, oval, fusiform, cylindrical, round, completely different forms (as if it were more clones). The color of fusiform types of tubers is brown-beige, the oval types has light brown background, reddish-brown scales (strong, dark). The size is uneven; the most common is thick, large tubers.

Topstar

The tuber's shape is from partially to strongly oval branched. The background color is light beige, with light brown scales. The sizes are much differentiated, the length is 4.0 to 8.0 cm, and the diameter is from 2.5 to 8.0 cm.

Gute Gelbe

The tuber's shape is round-oval, partly potato shaped, smooth. The background color is light brown (the buds), purple-red to dark brown for the scales, strong dark color. The length is approximately 4.0 to 15.0 cm and diameter is from 3.0 to 6.0 cm.

CONCLUSIONS

1. After the study conducted on the basis of information recorded in the specialty literature enough necessary data were structured to substantiate the nutritional value and the agronomic and economic importance of the Jerusalem artichoke.

2. The *Violet de Rennes* and *Gute Gelbe* late clones vegetate until October, reaching heights of four meters, while *Topstar* early clone grows up to a height of two meters.

3. A clear differentiation between the clones of Jerusalem artichoke can be difficult but the use of a detailed protocol for the leaves characterization can lead to the identification of strong recognition characters.

4. The inflorescence emergence date makes the obvious difference between the early *Topstar* clone which start blossoming from 5th of July and the late clones of *Violet de Rennes* and *Gute Gelbe* that bloom after 12th of September.

5. The studied Jerusalem artichoke clones have specific morphological shape, color and size of the tubers at the harvest moment.

REFERENCES

1. **Fernandez J., Curt M.D., Martinez M., 1988** – *Productivity of several Jerusalem artichoke (Helianthus tuberosus L.) clones in Soria (Spain) for two consecutive years (1987 and 1988)*, in *Topinambour (Jerusalem Artichoke)*, Luxembourg, Commission of the European Communities (CEC), p. 61–66, Report EUR 13405.
2. **Pas'ko N.M., 1973**– *Basic morphological features for distinguishing varieties of Jerusalem artichoke*, p. 91-101, Publisher: Genetike i Seleksii, 50(2).
3. **Stan N., Munteanu N., 2003**– *Legumicultură specială, Vol. II*, Editura: "Ion Ionescu de la Brad", Iași.
4. **Stanley J.K., Nottingham S.F., 2008** – *Biology and Chemistry of Jerusalem artichoke Helianthus tuberosus*. Publisher: CRS, New York,.
5. **Stolzenburg K., 2004**. – *Rohproteingehalt und Aminosäuremuster von Topinambur*, LAP Forchheim, Germany, <http://www.landwirtschaft-bw.info>.