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ASPECTS REGARDING THE CULTIVATION OF TOPINAMBOUR

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ABSTRACT

Jerusalem artichoke (Helianthus tuberosus L.) is a perennial plant whose tubers contain inulin, which can be used as raw material for healthy products, sweeteners, bioethanol and animal feed. The objective of this paper is o present some consideration about this very important plant for agriculture, medicine, food and health.

INTRODUCTION

Jerusalem artichoke *(Helianthus tuberosus)* – figure 1, has many names: sunroot, sunchoke, earth apple, Canadian truffle or topinambour. Topinambour is particularly common in Europe. It is a native North American plant and was widely cultivated by native tribes. The first place belongs to the Jerusalem artichoke (*Helianthus tuberosus I*.).

It produces many edible tubers, sometimes 2 inches in diameter, in our day mostly used for the feeding of cattle, horses and pigs, but which were precious to the Indians on account of their hardiness and prolificacy, retaining possession of the soil for many years. These tubers were mentioned by Champlainin 1603 and brought to France by Lescarbot, who in 1612 describes them as being "as big as small turnips, excellent to eat, with the taste of artichoke but more agreeable, and multiplying in a wonderful way."

The samples sent to France in the early 1600's were successfully grown and became quite a common food. There, it was known as Topinambour and it was eaten by both humans and animals. These days it is hard to find and considered a gourmet vegetable [21].

Jerusalem artichoke tubers are sold in shops in early spring and can be planted immediately. Jerusalem artichokes are very easy to grow, make very tall plants and display beautiful bright yellow flowers in summer. This gives away the fact that they are related to sunflowers. Plant tubers of Jerusalem artichoke at 15 cm deep and leave 30 cm between each tuber. Consider planting in an exposed area, to allow the mature plants to act as a windbreak [25].

Figure 1 - Helianthus tuberosus [22]

Jerusalem artichokes emerging from the ground in March

Jerusalem artichokes in May

The giant Jerusalem Artichoke in August

Flowering Jerusalem Artichokes

Figure 2 – Different stages of Jerusalem artichokes culture [23]

Among species in *Helianthus* genus, only two species have been exploited in agriculture. Sun flower (*Helianthus annuus* L.) is cultivated for seed oil, while tubers of Jerusalem artichoke (*Helianthus tuberosus* L.) are consumed [7]. Originated in the temperate climate of North America, Jerusalem artichoke has been introduced into different climates such as tropics. As Jerusalem artichoke tuber is rich in carbohydrate in form of inulin [6]. It is consumed as vegetable and used as raw material for making a variety of products including bio-ethanol, high fructose syrup, healthy food products and animal feed [12, 17]. Jerusalem artichoke is suggested to be perspective prebiotic fructan-containing additive for fermented symbiotic milks or oat-hydrolysate based products [8]. Jerusalem artichoke was previously considered to be underutilized crop. In the past, it served as food for indigenous people and the new settlers. It is also known as potato for the poor. At present, Jerusalem artichoke is considered as a new crop with high potential to serve several purposes. Jerusalem artichoke

now attracts the attentions of agronomists and breeders to improve its productivity in order that the production of Jerusalem artichoke will be viable and profitable in commercial scale in both temperate and tropical environments with or without irrigation.

Jerusalem artichoke is part of the *Asteraceae* (*Compositae*) family, being a perennial plant through its tubers, but with annual rods (stems). The stems are strong, sometimes branched at the base, with an average height of 1.5-2.0 m, and sometimes they can reach 3-4 m, with oval leaves covered with stiff bristles and flowers grouped in yellow capital, much smaller than those of sunflower [24].

It is a very vigorous, invasive species, with a tendency to invade the environment, thus becoming a plant / weed quite difficult to fight.

Jerusalem artichoke is a rustic plant, without special soil requirements and very well adapted to temperate climates, exploiting well all types of soil, even those very poor, except those with excess moisture, which withstands very well the frosts in during prolonged winter, and also the excessive drought.

This species is particularly favorable to the biological agriculture in our area, having very good productions without any special intervention, but due to the very long vegetation period and the cumbersome cleaning of the soil attached to the uneven tubers, it did not have a very wide spread.

The species itself is very less demanding for the soil fertility status, but it must be considered that, through the large productions achieved (tubers and stems), it is a plant that depletes the soil. Therefore, after this crop, in rotation, it must be done good organic-mineral fertilization and less demanding species of soil fertility must be cultivated [24].

Jerusalem artichoke (JA) (*Helianthus tuberosus* L.) is an economically important crop, which can be used as a human food and livestock feed, and as a source of inulin (as sweetener or for ethanol production) [8, 15]. JA is also easily grown in coastal and semiarid areas because of its high drought and salinity tolerance [10]. The economic benefit of JA is higher than grain crops; therefore, large areas of field used for main food production, for example wheat (*Triticum aestivum* L.), have been converted to JA plantation in China [9, 18].

As a major component of global biodiversity, soil microorganisms play pivotal roles in terrestrial ecosystem processes, including soil formation, carbon and nitrogen cycling, and plant nutrient acquisition [2, 19]. Plant litter and root exudates provide important carbon resources for soil microorganisms and changes in these plant-derived organic matters can affect soil microbial communities [11, 20]. Moreover, plant root exudates and litter chemistry differ among species and have different effects on below-ground ecosystem processes [1, 3, 11]. Therefore, changes in cultivated crop species can affect soil microbial community activity, composition and function [4, 5]. Knowledge about how land use conversion influences soil microbial communities is helpful for understanding how agricultural practices influence soil processes which are mediated by microorganisms and developing cultivation practices to increase crop growth and health through manipulating soil microbial communities [13].

Soil fungi represent an essential functional component of soil microbial communities as decomposers, mutualists and pathogens, and can affect plant growth and health in agroecosystems [2, 16].

MATERIAL AND METHOD

The use of Jerusalem artichoke in human nutrition, in the form of food supplements, in different recipes or through direct consumption, can have positive effects on human health. This is due to the fact that the Jerusalem artichoke tubers contain very high levels of inulin, which lowers the cholesterol to a very low content of fats (0.2%) and proteins (1.6%).

RESULTS AND DISCUSSIONS

Cultivation technology [24]

Multiplication is made only through whole tubers, the best results being obtained by using large and medium tubers.

It is planted in the spring (from February to April), directly in the field when the time allows, even in snowy mist, at a distance between rows of 70 cm, the distance between plants per row of 50-60 cm, the planting density of the crop being 9000- 11.000 plants / ha.

Tubers (1-2 pieces) are planted in nests at a depth of 8-10 cm.

Fertiliser

On sandy soils, apply 50 cubic metres of compost per hectare in the rotation or before planting. This supplies organic matter adds nutrients and helps retain moisture in the soil.

Apply the following rates of magnesium and trace elements before planting:

- 50kg/ha magnesium sulphate to supply magnesium;
- 20kg/ha manganese sulphate to supply manganese;
- 18kg/ha borax to supply boron;
- 18kg/ha iron sulphate to supply iron;
- 18kg/ha copper sulphate to supply copper;
- 18kg/ha zinc sulphate to supply zinc;
- 2kg/ha sodium molybdate to supply molybdenum.

Starting two weeks after emergence, topdress with a compound NPK fertiliser of around 12% nitrogen, 5% phosphorus and 14% potassium plus trace elements at rates of 200–300kg/ha every 14 days on infertile sandy soils, commencing with the lower rate.

The suggested fertiliser program is for a soil of low fertility. Test soil for phosphorus and irrigation water for nitrogen, phosphorus and potassium before planting.

Some phosphorus will be retained in sandy soils with a yellow or brown surface colour but not in grey or white sands. Some nutrients may be omitted or reduced if they are sufficiently high in the irrigation water and soil, or from compost and fertilisers from previous cropping.

Maintenance and harvesting

Exigencies of the species are minimal in maintenance works. The crop is irrigated only in extreme cases (excessive drought). In the areas with strong winds, the young stalks (25-30 cm) can be mowed to avoid their rupture, and during autumn they can be shortened to 1.50 m in height, when their height is disturbing.

Soil maintenance and weed control is done only through manual bites that are repeated as often as necessary (2-3 times, generally), and no further intervention is required.

Tubers are formed only in autumn. The crop cycle is between 180-210 days, and the production potential of the species is between 40-60 t/ha (4-6 kg/m^2) depending on the plant type and cropping system.

Jerusalem artichokes are usually harvested five to six months from planting but not until the tops die as yields increase up to this stage and immature tubers do not keep well. Slash the tops to facilitate harvesting. Handle the tubers with care as the skin is thin and easily bruised.

At harvesting, it should be achieved the careful assembly of all tubers, to avoid their uncontrolled spread in space.

Jerusalem artichoke also provides an important production of stems, which in autumn become woody, rigid, and they can be used as firewood or as poles for supporting other vegetables.

Health and Nutritional Value of Jerusalem Artichoke

Tubers contain about 15% inulin. This is a short chain of fructose molecules. There have been many effects of inulin reported including increase in beneficial bacteria in the gut and reduction of harmful bacteria such as Clostridium perfinges. Inulin is classified as a prebiotic, because it supports the growth of beneficial bacteria in the bowel.

Nutritionally (Table 1), the dry Jerusalem artichoke contains about 10% protein, no oil, and no starch. Unlike most root vegetables including the potato, it stores its reserves as the carbohydrate inulin (76%), a polymer of the monosaccharide fructose. The inulin gradually reverts to fructose when the tuber is stored. Since fructose tastes one and a half times sweeter than sucrose, Jerusalem artichokes have a sweet taste. Jerusalem artichoke have been suggested as healthy choice for diabetics because fructose is tolerated better than sucrose. Jerusalem artichoke have been a folk remedy for diabetes [21].

Table 1

Nutrient content of fresh Jerusalem artichoke (unit) [21]

Characteristics	Amount per 100 gram
Water (grams)	78
Energy (kcal)	73
Protein (gram)	2
Fat (gram)	0.1
Carbohydrate (gram)	17
Fiber (gram)	1.6
Sugars (gram)	9.6
MINERALS (mg)	
Calcium	14
Iron	3.4
Magnesium	17
Phosphorus	78
Potassium	429
Sodium	4
Zink	0.1

CONCLUSIONS

Jerusalem artichoke is a plant with multiple uses in the field of food: food supplements, food, feed, but also energy: green leaves and stems and biogas tubers resulting from the production of biogas for compost and dried stems for obtaining pellets / agri-pellets.

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