Jerusalem artichoke

(*Helianthus tuberosus L.*)

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Origin and distribution

Helianthus tuberosus L., Jerusalem artichoke, is a native of North America. It is a perennial of the Asteraceae family (Compositae) that is grown as an annual. The tops die off in the early winter at which time the tubers are harvested. There are many cultivars and the cultivar selected depends upon the production location.

The Jerusalem artichoke (Helianthus tuberosus) belongs to the large Compositae family, which includes lettuces, sunflowers and globe artichokes. It grows to a height of 2 to 3 m and a width of 0,6 m. The plant resembles a sunflower, but it also produces a large number of edible tubers, which are knobbly and resemble ginger in appearance. This distinguishes the plant from the globe artichoke which is grown for its immature flowers. The tubers are smaller, sweeter, crisper and nuttier than potatoes.

Soil and climatic requirements

A hardy, tall, herbaceous perennial that grows up to 3 m high with a yellow flower like a sunflower, grows in any soil, but prefers light, sandy soil of good fertility. It does best in temperate climates, to the point of becoming an ‘‘edible weed’’ in some gardens. In warmer, more humid areas it can still be very productive, but it is unlikely to persist in the ground from year to year. It will need to be replanted from stored tubers. Tubers store well in the crisper part of the fridge in a plastic bag. In tropical zones it can be grown successfully year round by regular replanting, but it is best planted at the beginning of the wet season.

Although the plant adapts well to a wide range of soil types and pH levels, artichoke production is favoured by slightly alkaline soils. Yields are poor on heavy clays, particularly if there is water-logging. Tuber and top yields are limited if soil moisture is less than 30% of field capacity during the tuber formation period (early September to November).

Jerusalem artichoke is a spring and summer growing plant. Crops planted between September and November usually give the best yields. Harvesting usually takes place between March and May. Frosts cause severe damage to young plants and planting should be delayed until after the normal time for the last frost. The plant requires a maximum of 140 frost-free days to produce good crops. However, when the foliage has died down, frosts may improve the flavour of mature tubers in the ground. Loams, or well–fertilised, slightly acid to neutral sandy soils, are preferred.

Uses

The plant can be grown for human consumption, alcohol production, fructose production and livestock fodder. Directly after harvest, the carbohydrates are in the form of inulin and are good for dieters and diabetics. The inulin changes gradually in storage to other starches and should then be regarded as similar to a potato by diabetics.

Human food

Similar to water chestnuts in taste, the traditional use of the tuber is as a gourmet vegetable. Jerusalem artichoke tubers resemble potatoes, except that the carbohydrates composing 75 to 80% of the tubers are in the form of inulin rather than starch. Once the tubers are stored in the ground or refrigerated, the inulin is converted into fructose and the tubers develop a much sweeter taste. Dehydrated and ground tubers can be stored for long periods without protein and sugar deterioration. Tubers can be prepared in ways similar to potatoes. In addition, they can be eaten raw, or made into flour, or pickled. They are available commercially under several names, including sunchokes and lambchokes.

Alcohol production

In France the artichokes have been used for wine and beer production for many years. Ethanol and butanol, two fuel-grade alcohols, can be produced from Jerusalem artichokes. The cost of producing ethanol currently is not competitive with gasoline prices, and, therefore, the success of ethanol plants has been limited.

Fructose production

About 50% of the 12 million tons of sugar consumed annually by Americans is grown and produced in the United States. Fructose is more soluble in water than sucrose, so fructose provides more desirable syrup.

In addition, it is 1,5 times sweeter than sucrose and can be consumed safely by diabetics.

The majority of domestically produced fructose is obtained from maize (corn). Although the Jerusalem artichoke is a viable fructose source, the U.S. sugar industry has been reluctant in utilising it because farmers have been concerned about its potential as a weed problem and because it requires extra planting and harvesting equipment and there are storage difficulties.

Forage production

The quality of artichoke tops makes them a suitable livestock fodder, but the forage quality has no advantage over other fodder crops and tops should be classified as a maintenance feed. Both crude protein and digestible protein concentrations are low when compared to alfalfa. Artichoke tops are superior in TDN (total digestible nutrients) to the perennial fodder crops listed, but they have lower TDN than maize silage.

Optimal forage quality can be obtained by harvesting tops during mid-September when protein levels will be at their maximum. However, tuber yields will be reduced at this time. The smaller size may make the tubers unharvestable. For greater tuber production, it is more advantageous to harvest the tops after a severe frost. Protein levels in the forage will be reduced, but will still provide an acceptable feed. Roots, tubers and tops can be fed as a combined ration. Tops can be fed fresh or ensiled, although the forage does not ensile well because of its high concentration of soluble sugars and high moisture content. The potential advantage of the fodder crop may arise from the fact that it adapts well to a wide variety of soils and habitats.

Health benefits

Jerusalem artichokes produce a large number of edible tubers. They are especially suitable for diabetics as they contain no starch; the carbohydrate is in the form of inulin and laevulin, which are readily metabolised as the natural sugar, laevulose. Tubers should be scrubbed, not peeled,

and can be boiled or baked, or when very fresh they can be grated raw into salads. This plant is also a useful summer windbreak for the vegetable garden. It can be used for animal fodder; the tops can be grazed down in autumn, before harvesting. It is a convenient fodder crop for pigs, as they can root up the tubers themselves.

The attractive flowers can be cut as a ‘‘cut flower’’ —removing the flowers is believed to increase the yield of tubers.

Cultivation practices

Soil preparation

When choosing a site for planting Jerusalem artichokes, it is best to make it a permanent location. These plants are very hardy and, once established, can be difficult to eliminate.

Artichokes are very tolerant of soil conditions, and minimal soil preparation is needed. They grow very well under a mulch of rotted hay or straw. Once they have started growing, they compete very successfully with weeds.

The soil should be tilled well. It must be free of perennial weeds and grasses. Additions of compost or manure promote good fertility for crop growth. Ordinary vegetable garden fertility is adequate.

Planting

Propagation is by tubers; any small piece left in the soil after harvest will probably shoot, so plant the crop where you want it to grow, as it can be hard to eradicate (in cooler areas). The recommended planting time is spring. To plant, cut the tuber into two or three sections, each one with an “eye”; cover the tubers with soil to a depth of 10 cm. Plant in rows 70 cm apart, 25 cm between plants in full sun and mulch well. Jerusalem artichokes need a good supply of potassium: this can be supplied with wood ash, avoid high nitrogen fertilisers or the tops will grow at the expense of the roots.

Select tubers about 25 to 35 mm in diameter. Larger tubers should be cut up into similar sized pieces with two eyes, or buds, per set. Too many buds result in multistemmed plants and a large number of small tubers that are difficult to prepare.

Sowing the tubers in mid-winter about 100 mm below the soil allowing 450 mm between plants is best recommended. As they grow to a height of 2 m or more, they can form a useful summer windbreak. Flowering affects both

tuber size and quality, so cut off the flower buds. The tubers are mature enough to use for about a month following the formation of the flower buds, but are generally eaten during the winter months. The tubers will store well in sand provided they are kept cool.

Fertilisation

Crops grown on sandy soils may benefit from applying compost at up to 50 m^3/ha in the rotation, or before planting. This will supply organic matter, add nutrients and help to retain moisture in the soil.

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

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

Apply double superphosphate at a rate of 500 to 700 kg/ha before planting. Do not use ordinary superphosphate. This contains higher levels of cadmium, which is a toxic heavy metal.

Apply urea at 60 kg/ha and muriate of potash at 60 kg/ha as side-dressings to light sandy soils every one to three weeks, until two months from harvesting. Apply magnesium sulphate at 100 kg/ha at one and two months after planting.

It is recommended that nutrient analyses should be made of the soil and irrigation water before planting, as well as one to two analyses of the youngest mature leaves after planting.

This will enable some adjustments to the fertiliser programme and provide information on nutrients that are deficient or occur in toxic quantities. Some of the suggested nutrients in the programmes in this publication may be deleted or reduced, if it is obvious that they are sufficiently high in the irrigation water and soil, including sources from compost and fertilisers from previous cropping.

Do not apply excess fertilisers, because nitrogen, phosphorus and potassium are easily leached from sandy soils by rainfall and irrigation. This may lead to groundwater pollution of rivers and estuaries.

Irrigation

Four to five irrigations may be needed for optimum yields. Regular garden watering gives the best tuber production, but Jerusalem artichokes can tolerate dry periods.

Weed control

Cultivate between rows to control weeds when the plants are young. The last cultivation should be before the plants are 1 m tall. At this stage, the tubers begin to form around the base of the plant and must not be disturbed. Artichoke plants will shade out most weeds from this stage to maturity.

1. Mechanical—Jerusalem artichoke plants are extremely vigorous and will compete strongly with weeds. Early season cultivation is recommended to reduce emerging weeds, with a subsequent tillage operation to improve the hilling of rows.
2. Chemical—There are no herbicides currently registered for use on Jerusalem artichokes.
3. Control of Jerusalem artichokes in subsequent crops—Tubers overwinter very well in the soil. As a result, volunteer Jerusalem artichokes can be a serious weed problem in the following crop. It spreads into other crops and will grow even taller than maize. One possible herbicide treatment to eliminate Jerusalem artichoke is Roundup (glyphosate).

Pest control and disease control

Insects

Insects have not been serious problems, but the potential is greater in the case of a large number of hectares. Stalkborers have been observed, but they usually cause limited damage. No insecticides are currently registered for use on the crop.

Diseases

Few diseases are reported to affect Jerusalem artichokes. The primary disease is Sclerotinia (white mould), which can cause early wilt, stalk rot and degradation of the tubers. This pathogen also can cause severe yield reductions in dry edible beans, sunflowers, and soya beans.

If possible, susceptible crops should be rotated with small grains or maize. Avoid close rotations with dry, edible beans, sunflowers, safflower, mustard and soya beans. Diseases such as downy mildew, rust and southern stem

blight have been reported but have not been of economic importance. No fungicides are currently labelled for Jerusalem artichokes.

Harvesting and handling

Tubers can be harvested four to six weeks after flowering. Even though the flowers are pretty, yields will be better if the flower buds are pinched off as soon as they appear. In cooler areas with well-drained soils it is better to dig up the tubers only as you use them. In subtropical areas and poorly drained soils the tubers may rot if left in the ground once the tops die back, so it is better to dig up the entire crop in one operation. Tubers do not store well out of the ground. Carefully store them in slightly damp sawdust or sand in a dark place; or store them in a perforated plastic bag in the bottom part of the fridge.

Harvesting the tuber crop is similar to potatoes, with a few exceptions. The potato vine is weak and usually has senesced before harvest, which is in contrast to the continued growth of the strong artichoke stems. Potato tubers separate easily from the stems, while the large mass of artichoke tubers are strongly attached and intertwined with the roots. By adding small chains and increasing agitation, you can convert a potato digger into a Jerusalem artichoke digger. Artichoke tubers are smaller than potatoes, so these modifications are necessary to reduce the potential 50% loss that is possible with a conventional potato digger. Tops, roots and tubers can be sorted as they are harvested, or they can be dried and then sorted. Artichoke tubers will wilt and soften much faster than potato tubers and therefore cannot be left at low humidities too long before storage.

References

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