

# ORGANICKÉ PĚSTOVÁNÍ JAKONU [*SMALLANTHUS SONCHIFOLIUS* (POEPP. & ENDL.) H. ROBINSON]

## *Organic farming of yacon [Smallanthus sonchifolius (Poepp. & Endl.) H. Robinson]*

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**Summary:** Yacon is a crop cultivated for its tuberous roots, which contain fructooligosaccharides of inulin type  $\beta$  (2 $\rightarrow$ 1) with positive effects for diabetics and people suffering from overweight. Yacon is also very rich source of antioxidants occurred mainly in leaf. Yacon is organic cultivated on the experimental trials of the Czech Agricultural University in Prague already for 12 years. Plant material resources originated from Bolivia, Ecuador, Germany and New Zealand are planting out on organic fertilized field in the middle of May; at the beginning of vegetation the field is maintained without weeds by mechanic cultivation; by line weeding of ridge, later by ridging. After yacon covering the soil weed out is not further necessary. Yacon does not suffer from serious diseases nor pests. Yield of tubers is to the certain extent rainfall dependent, therefore irrigation is necessary during hot summer days. Harvest of tuberous roots is done before the first autumn frost. Firstly the above-ground part of yacon is cut by hand and harvested, after that tuberous roots are tilled with the help of specially modified harvester. Average yield of tuberous roots was 25.51 t/ha (2001-2005) and above-ground parts 36.94 t/ha. The yacon vegetation is on average 163 days.

**Key words:** yacon, *Smallanthus sonchifolius*, tuberous root, organic agriculture, yield

**Souhrn:** Jakon je pěstován pro kořenové hlízy, které obsahují fruktooligosacharidy inulinového typu  $\beta$  (2 $\rightarrow$ 1) s příznivým účinkem pro diabetiky a lidi trpícími nadváhou. Jakon je rovněž velmi bohatým zdrojem antioxidantů obsažených především v listech. Na pokusných pozemcích Institutu tropů a subtropů - ČZU se jakon organicky pěstuje již 12 let. Rostlinný materiál získaný z Bolívie, Ekvádoru, Německa a Nového Zélandu je vysazován na organicky vyhojené pole v polovině května; z počátku vegetace je bezplevelný stav pole udržován mechanicky pomocí plečkování hrůbků, později hrůbkováním. Po zapojení porostu již další odplevelování není zapotřebí. Jakon netrpí závažnými chorobami ani škůdci. Výnos hlíz je do značné míry závislý na úhrnu srážek, proto je během horkých letních dnů nutná závlaha. Sklizeň kořenových hlíz se provádí v říjnu. Nejprve se ručně poseká a sklídí nadzemní část jakonu, poté se vyořou hlízy za pomoci speciálně upraveného sklízeče. Průměrný výnos kořenových hlíz činí 25,51 t/ha (2001-2005). Délka vegetace činí v průměru 163 dnů.

**Klíčová slova:** jakon, *Smallanthus sonchifolius*, kořenová hlíza, organické zemědělství, výnos

### Introduction

Yacon [*Smallanthus sonchifolius*, (Poepp. & Endl.) H. Robinson; *Asteraceae*], syn. *Polymnia sonchifolia*, is a perennial plant of the Andes; however, it is considered an annual in the cultivation system. It is traditionally grown for its root tubers and medicinal infusion from leaves rich in phenolic components with strong antioxidant effects (Lachman et al., 2003). Yacon is highly adaptable to various climates and altitudes (Zardini, 1991). It can tolerate temperatures as low as 4°C. The optimal development is reached within 18°C and 25°C. It needs near 200 days of no-frost climate before the tuberous roots are ready for harvest (Grau and Rea, 1997). The mature plants possess well-developed foliage, with a high transpiration capacity, so that they require a regular and important water supply. Yacon grows better in soils slightly retentive of humidity, with regular watering. Yacon develops well within a wide range of soil conditions; its development is favored by deep, well-tilled soils, rich or moderately rich in organic matter and well drained. It can tolerate a wide range of pH, from acid to slightly alkaline (León, 1964). In terms of the root tubers formation, yacon was described as a crop with negative reaction to photoperiod (Popenoe et al., 1989). The yacon leaves has got di- and

sesquiterpenes with protective effects against insects are present (Katuka et al., 1992), This property allows cultivation of yacon without pesticides, what is prerequisite good for organic farming of cultivation and utilization of yacon like dietetic food and raw material for production of bioproducts.

The first introduction of yacon in Europe was made in 1927 in San Remo, Italy. After 13 years of adaptation it was recommended to use yacon as a source of dietetic nutrition and as a feeding crop, but mainly as a material for sugar industry (Calvino, 1940). Since Calvino's experiments yacon extended in Germany in 1941, in Hamburg and Wulfsdorf (Bredemann, 1948). Yacon has also been introduced into the Czech Republic, where it has been grown since 1994. Besides the Ands region growing yacon has also been extended in Brasil, Japan, Korea, Mexico, New Zealand, the United States, Russia, Estonia and Taiwan.

In this work the results of the yield tuberous roots of yacon organically cultivated under the climatic condition of the Czech Republic in the years 2001-2005 are presented.

## Material and methods

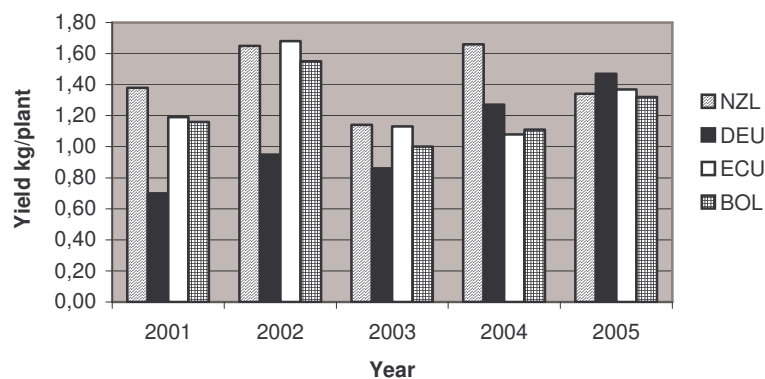
Four different landraces of yacon were observed: NZL (New Zealand), DEU (Germany), ECU (Ecuador) and BOL (Bolivia). Plants were cultivated on the experimental fields of the Czech University of Agriculture in Prague, which are situated in an average above the sea height of 286 m, on 50°04' north latitude and 14°26' east longitude and have loamy soils. The climatic area is mildly warm and mildly dry. An average year temperature ranges around 8.7°C (an average daily temperature during vegetation is 15.0°C, 2001-2005) and average precipitation is 516.1 mm (325.22 mm during vegetation). The meteorologic information was taken from the meteorological the nearest station (Prague-Ruzyne), which is situated on 364 m altitude, on 50°06'03" north latitude and 14°15'28" east longitude (<http://www.chmi.cz/meteo/ok/infklim.html>).

The planting on a field site was operated during the time, when the spring frosts were definitely over (mostly in the second half of May) to soil applied with organic fertilizer (cattle manure, 20 t.ha<sup>-1</sup>). Plants were planted in ridges in spacing 0.70 x 0.70 m. Yacon's beginning growth is somewhat slow; at the beginning phase its resistance to weeds is very small. Hoeing was performed approx. 30 days after the outplanting, so the inter-rows were ploughed and the weeds were destroyed. The ridging was performed approx. two months after the

outplanting; it not only formed the ridges, but it also helped to get rid of the weeds. Once the growth was fully involved, there was no need for other cultivation actions, as yacon was resistant to weeds, and further interventions could seriously harm the developing tubers. At the beginning of the growth and during the development of the storage organs, it was necessary to water sufficiently the plants, especially during the dry seasons. It is advisable to shift the harvest as far as possible; however the above ground biomass, and especially the root tubers, must not be damaged by the autumn first frosts (October). The above ground part was removed before the harvest, so the under ground parts were manipulated better and it also eased the manual harvest. Also, for the purpose of mechanical harvest, a test of a truncated puller constructed specially for the harvest of yacon was performed, and it was successful. After the harvest of the under ground part, the root and stem tubers were separated from each other. All cut parts on the stem tubers were treated with charcoal or at least they were let dry. Bigger cut parts on the root tubers were treated in the same way. The tubers determined for consumption were placed in boxes and stored in a cool and moist room at the temperature of around 10°C; this prevented the tubers from losing of water and from shrinking.

## Results

Figure 1: Yield of tuberous roots of different landraces per year



Yacon crop has an aptitude to adapt to different climatic conditions. Thanks to this, in conditions of the Czech Republic high yields of tuberous roots. A plant forms in average 1.25 kg. plant<sup>-1</sup> of tuberous roots (i.e 25.51 t. ha<sup>-1</sup>). According to the averages of the yield of tuberous roots obtained during the observed years, the landraces can be arranged in decreasing order: NZL (29.18 t. ha<sup>-1</sup>) > ECU (26.33 t. ha<sup>-1</sup>) > BOL (25.10 t. ha<sup>-1</sup>) > DEU (21.43 t. ha<sup>-1</sup>), figure 1. The biggest yield of tuberous roots was obtained in the year 2002 (1.46 kg.plant<sup>-1</sup>), but no statistically significant differences were found in the years 2004 and 2005. The lowest yield of tuberous roots was obtained in 2003 (1.03 kg plant<sup>-1</sup>), figure 1. In 2002 the highest rainfall precipitation during the vegetation was measured

(387.02 mm), however in the year 2003 (211.49 mm) the lowest rainfall precipitation. The highest average temperature during the vegetation was measured in the year 2003 (15.90°C), and at the same time this year was the driest. The year 2004 was from the growing seasons the coldest with average temperature of 13.90°C and the average of yield of tuberous roots in this year was 1.28 kg plant<sup>-1</sup>. In the most productive year (2002) the average temperature during the vegetation was 15.20°C. These results confirm that the precipitation is the main factor for the formation of tuberous roots in yacon. It seems that the temperature does not have great effect on the formation of tuberous roots. Yacon is a tolerant crop against the oscillation of temperatures because it can withstand high temperatures in the

summer as well as low temperatures about the point of freezing in autumn. The first frosts in autumn can cause yacon burns (with the frost) beginning on the overground part, which is 1 meter above the ground (-1°C). Basal parts of the stem resist at -2 °C and underground organs at -3 °C. Under lower temperatures the tuberous roots crack.

Although some authors recommends use of some industrial fertilizers (for example 160 kg. ha<sup>-1</sup> nitrogen and 100 kg. ha<sup>-1</sup> of potassium for yield of tuberous roots 51 t/ha, Seminario et al., 2003), in Czech conditions organic farming and 40 t. ha<sup>-1</sup> of cow-dung which is applied in autumn supply sufficient yield of tuberous roots with a good quality.

## Conclusions

Yacon, an important Andean species grown for its juicy tuberous root, is potentially beneficial in the diet to diabetics. Moreover, fructooligosaccharides forming a major proportion of yacon tuber dry matter are known for their ability to keep the human colon healthy. Yacon is effortless to grow and has no problems with pests or

diseases due to protective effects of its di- and sesquiterpenes. Regarding the fact that yacon could be cultivated under climatic conditions of the Czech Republic, it seems that it could be a good source of raw material for the assortment of nutraceuticals of domestic origin.

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