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Yacon, a Potential Tuberous Crop for Florida[1]

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Yacon (*Smallanthus sonchifolius* (Poepp. and Endl.) H. Robinson), a member of the sunflower family Asteraceae, is a tuberous root species (Figures 1 and 2). Yacon looks like Jerusalem artichoke; it is native to the Andean region of South America, where it has been cultivated in Argentina, Bolivia, Brazil, Ecuador, and Peru for a long time. Yacon is also known as Bolivian sunroot, ground pear, llacon, pear of the earth, Peruvian ground apple, and strawberry jicama (Hermann and Heller 1997).

Yacon is considered a functional food (Caetano et al. 2016; Carvalho et al. 2020; Sanin et al. 2020). This is largely attributed to the high nutraceutical and pharmaceutical values of its tubers. Yacon shoots can be used as forage for livestock husbandry, and the leaves are an excellent protein source, containing 11%–17% protein based on dry matter.

There is an increasing interest worldwide in production of yacon (Ojansivu et al. 2011; Yan et al. 2019). Yacon tuberous roots have become an attractive food in US vegetable markets (Silva et al. 2018). It is not listed as an invasive species. Florida is a major producer of specialty crops in the nation, and growers have expressed their interest in yacon production. The purpose of this article is to introduce yacon as a potential crop to Florida growers and the Extension community by providing information on its propagation, production, and utilization as well as nutritional value. It is anticipated that the availability of such information will support the establishment of yacon as a higher-value crop and promote yacon production and utilization in Florida.

Figure 1. Yacon production in Florida.
Credits: Jianjun Chen, UF/IFAS

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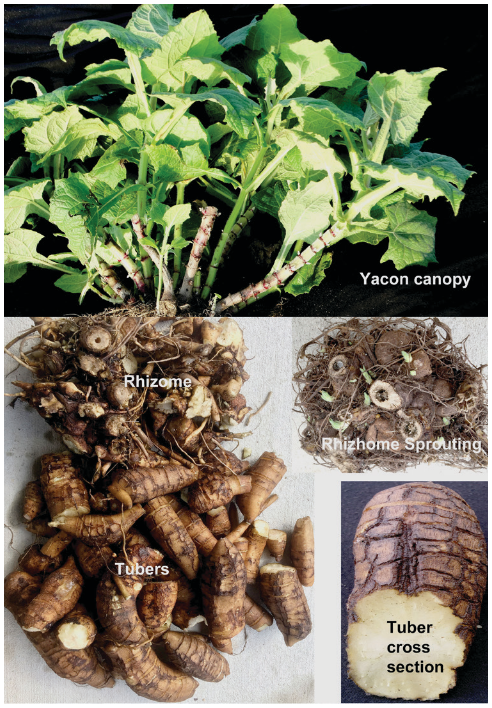

Figure 2. Canopy, rhizomes, rhizome sprouting, tubers, and tuber cross section of yacon plant.
Credits: Jianjun Chen, UF/IFAS

Brief Biology

Yacon is an herbaceous perennial crop but grown as an annual vegetable. The tuberous roots are adventitiously grown from a ramified stem formed by short, thick sympodial rhizomes (Figure 2). The carbohydrate growth is caused by the proliferation of parenchymal tissue in the root cortex (vascular cylinder) (Hermann and Heller 1997). The plant produces two types of underground organs: (1) corms or rhizomes at the base of the stem, which are mainly used for propagation, and (2) larger, yellowish tuberous roots underneath the corms. The tuberous roots taste sweet like apples and pears and are mainly for fresh food consumption. The spherical or pear-shaped tuberous roots (Manrique et al. 2005) can extend up to 16 inches long (Figure 2) (Lachman et al. 2003) and weigh 0.4–6.6 lb, exhibiting white, yellow, or pink skin colors depending on variety (Manrique et al. 2005; Lachman et al. 2007).

Yacon plants grow best at 64°F–80°F (Silva et al. 2018) but can tolerate temperatures as high as 105°F and as low as 32°F. Yacon production has been expanded to other subtropical and temperate regions. This crop takes approximately 180 days from planting to maturity in Florida. It prefers loamy sandy (Fernandez et al. 2006) acid to slightly alkaline (Herman and Heller 1997) soils rich in nutrients. The roots are mainly fusiform, but they become irregularly shaped if grown in very gravelly Krome loam soil in the Miami Ridge in southern Florida. The plant can grow up to 8 feet tall (Wagner et al. 2019), and stems and leaves have trichomes (Lachman et al. 2007; Lachman et al. 2003).

Yacon Production

Propagation

Yacon can be propagated by seed, stem cutting, tissue culture, and corm (Figure 2). Seed propagation is uncommon because not all varieties can produce abundant seeds. Stems can be easily rooted, and rooted cuttings are used for production. Tissue-cultured liners are available in Florida, and the liners can be directly planted in the field. However, for high-yield production in the same season, corms are widely used as the primary propagule (see sprouted rhizomes or corms). At the time of harvest, corms are separated from stem and tuberous roots and stored in the refrigerators. About two months before production, corms are placed in potting soil to allow sprouting. Sprouted corms are separated and placed in 6-inch or 8-inch pots filled with potting soil to allow plant growth. Then, the young plants can be directly transplanted into the field. The Cultivariable website lists 12 varieties with their agronomic and culinary traits. The varieties include Bekya, Blanco, Bogachiel, Cajamarca, Kalaloch, Late Red, Morado, New Zealand, Quinault, Rojo, Rose, and Sol Duc (https://www.cultivariable.com/yacon-variety-comparisons/).

Yacon Cultivation

Yacon plants are day-neutral, have no photoperiod restriction for corm and root formations, and are tolerant to temperature oscillations. Precipitation or irrigation and low-temperature nights are crucial for corm and root formations (Fernandez et al. 2006). With a wide temperature range (32°F to 105°F) of adaptation, yacon may have one crop in spring or two crops in spring and fall growing seasons per year for north and central Florida, respectively. Soil should be prepared according to EDIS publication HS503, *Soil Preparation and Liming for Vegetable Gardens*, at https://edis.ifas.ufl.edu/vh024 (Stephens and Liu 2016). The prepared land should be kept moist. At planting (commonly in spring), rooted stem cuttings or plants propagated from corms can be planted in beds with 3- or 4-foot center-to-center spacing (Chqoue Delago et al. 2013) with 30–40 inches for plant spacing (Herman and Heller 1997). Nitrogen application can increase fructooligosaccharide content and yield (Wagner et al. 2019). Ammonium sulphate and controlled-release fertilizers are commonly used. There is no specific fertilizer recommendation currently available for growers to follow. Because yacon and lettuce belong to the sunflower family, Asteraceae, for the time being growers can follow the recommendations for potato production:

nitrogen, 200 lb/acre, and 0, 100, or 120–150 lb/acre of either P_2O_5 or K_2O for high, medium, and low soil test index using Mehlich-3 soil extraction method, respectively. Please see Chapter 2 in the *Vegetable Production Handbook of Florida* for more details (Liu et al. 2021).

Disease and Pest Control

Yacon leaves and stems have pest-resistant and antimicrobial properties due to the contents of monoterpenes, diterpenes, and sesquiterpenes (Yan et al. 2019). The trichomes present on leaves and stems are a second defense mechanism against pathogens (Fernandez et al. 2006; Tudu et al. 2017). Preliminary evaluation of yacon in Florida showed that mealybug and whitefly infestations occurred if they were produced in greenhouses. However, disease and pest problems were not encountered during field production except nematodes that were found in roots. It is recommended to use raised beds with plasticulture to minimize weed pressure.

Disease and pest problems have been reported in other parts of the world. Generally, the main diseases occurring on yacon include *Fusarium* spp., *Erwinia chrysanthemi*, *Sclerotinia* spp. and *Alternaria* (Hermann and Heller 1997). The major insects damaging this crop are slugs (*Ariolimax* spp.: Limacidae) and caterpillars (*Chlosyne laciniasaundersii*) (Tudu et al. 2017). Leaves, roots, and flowers can also be damaged by *Liriomyza* spp., *Diabrotica undecimpunctata* (cucumber beetle), *Diabrotica speciosa* (cucurbit beetle), *Agrotis ipsilon* (cutworms), *Schistocerca* spp., and two other insects of the Acrididae and Trydactydae families. The underground structures have also shown damage by *Golofa aegeon* (scarab beetle) and *Passalus* spp. (betsy beetles). Sucking insects such as green leafhopper (*Empoasca* spp.) and aphids (*Aphis* spp. and *Myzus persicae*) have lower occurrence (Tudu et al. 2017). The main pest and disease management approaches used for yacon production are chemical and biological. Contact or systemic insecticides (pyrethroids or neonicotinoids) have been applied as chemical control. The biological control approach includes the bacteria *Klebsiella oxytoca* and *Erwinia uredovora*. Additionally, the natural predator insect *Cycloneda* spp. has been reported as well (Tudu et al. 2017). Because yacon is new to Florida, registered chemicals for yacon production are not available in Florida.

Harvest and Postharvest Handling

Yacon roots mature 6–7 months after planting in South America (Fernandez et al. 2006), which is about the same in Florida. The corm and root can be harvested mechanically or manually (Manrique et al. 2005). Both one-time harvest for commercial production and multiple harvests for home gardeners may be practiced. The shelf life of yacon roots can be extended from 4 months at 50°F to a year at 35°F (https://www.cultivariable.com/instructions/andean-roots-tubers/how-to-grow-yacon/). Vacuum drying is an effective method to extend the roots' shelf life, but it is costly (Choque Delgado et al. 2013).

Quality and Uses

Yacon roots should be chopped or sliced for use as a raw vegetable or in salads (Tudu et al. 2017). Because they brown quickly due to the abundant phenolic compound content and oxidation of the compound (Choque Delgado et al. 2013), the roots (8–12 °Brix) are rarely cooked but are used to produce yacon syrup (with 73 °Brix) (Manrique et al. 2005). An extract from yacon tuberous roots is used as a sweetening agent. It can also be added to ice cream, processed into stews and chips, fermented into pickles, and made into desserts. Furthermore, "chancaca" is a concentrated sweetener obtained from the boiling process and crystallization of the root juice (Choque Delgado et al. 2013). Additionally, just like agar, arrowroot powder, and tapioca flour, yacon roots can also be used as a yogurt stabilizer or thickener and a low-calorie sweetener in cheese and milk drinks (Yan et al. 2019).

Yacon Nutraceutical and Medicinal Properties

Yacon tuberous roots accumulate carbohydrates in the form of fructooligosaccharides (FOS) (Goto et al. 1995; Lachman et al. 2003). FOS are oligosaccharide (from the Greek, oligos, "a few" and sácchar, "sugar") fructans and are used as a sweetener. An oligosaccharide is a saccharide polymer having 3 to 10 simple sugars. Data from human studies are still only few, but the data collected from research on animals clearly indicate that inulin/oligofructose have a significant impact on the immune system and may possibly reduce the risk of cancer (Caetano et al. 2016; Machado et al. 2018; Watzl et al. 2005). Thus, consumption of yacon tuberous roots may be beneficial to human well-being.

Due to its low glycemic index (Trinidad et al. 2010), consuming yacon tubers reduces excess body weight. The glycemic index (GI) is an indicator used for ranking carbohydrate in foods based on their effect on blood glucose levels. The GI scale ranges from 0 to 100. Pure glucose has the highest GI, i.e., 100. Foods that are quickly digested and absorbed or transformed metabolically into glucose have a high GI. For human well-being, particularly for those with diabetes, a diet with a GI lower than 55 can be beneficial. A low-GI diet can curb blood sugar spikes and lower risk of diabetes. Carrots, oatmeal, peas, and most fruits and vegetables all have a GI lower than 55. The yacon tuberous roots have a GI of approximately 34 (Trinidad et al. 2010), and thus they are considered a healthy and functional food (Oliveira, Braga, and Fernandes 2013; Martirosyan and Singh 2015). The tubers contain more than 70% of water and 0.7%–13.2% of FOS (fresh weight basis) or 6.4%–70% of FOS (dry weight basis) (Cateano et al. 2016; Machado et al. 2018; Yan et al. 2019); tubers also contain 2%–3% of proteins (dry weight basis) (Choque Delgado et al. 2013). Yacon is rich in mineral nutrients, such as phosphorus, potassium, calcium, iron, copper, manganese, zinc, and vitamins, such as retinol (vitamin A_1), carotene (also carotin, from the Latin, carota, "carrot"), ascorbic acid (vitamin C), thiamin (vitamin B_1), riboflavin (vitamin B_2), and niacin (vitamin B_3) (Lachman et al. 2003).

The FOS (kestose, nystose, and fructofuranosylnystose) present in yacon roots are considered prebiotics because they favor *Bifidobacterium* spp. and *Lactobacillus* spp. proliferation and actively reduce pathogenic bacteria populations (*Clostridium* spp. and *Escherichia coli*) (Wagner et al. 2019). Fructofuranosylnystose is a natural product ($C_{30}H_{52}O_{26}$) found in *Saussurea costus*, formerly known as *Dolomiaea costus*. FOS are substrates to regulate the immune response, glucose, and lipid homeostasis. As a result, yacon roots and yacon-based products can be used as a dietary supplement (Caetano et al. 2016).

The yacon leaves and roots (infusions) are a source of phenolic compounds (chlorogenic, protocatechuic, ferulic, rosmarinic, gallic, gentisic, and caffeic acids) (Lachman et al. 2007), flavonoids, and tryptophan, with antioxidant (Fernandez et al. 2006), anti-inflammatory, antimicrobial, and anticarcinogenic properties (Caetano et al. 2016). There is evidence that the phenolic compounds present in yacon roots may protect DNA, lipids, and proteins from damage caused by free radicals (Choque Delgado et al. 2013). Regular consumption of yacon roots can stimulate calcium intestinal absorption (Campos et al. 2012), regulate serum cholesterol (Choque Delgado et al. 2013), modulate thrombosis, increase immune system efficiency, and reduce allergenic digestive reactions (Caetano et al. 2016).

Summary

Yacon is a valuable crop (Lachman et al. 2003) that may become increasingly profitable in Florida due to its day-neutrality (Silva et al. 2018) for corm and root formation. Environmentally, the crop can reduce soil erosion and tolerate partial shade and, hence, is ideal for agroforestry systems (Hermann and Heller 1997). This vegetable can increase market and food diversity and enhance the competitiveness of Florida's vegetable industry. The state's unique geography and climate present advantages for yacon production. Florida growers can grow this root vegetable with competitive economic returns.

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References and Further Reading

Caetano, B. F. R., N. A. de Moura, A. P. S. Almeida, M. C. Dias, K. Sivieri, and L. F. Barbisan. 2016. "Yacon (*Smallanthus sonchifolius*) as a Food Supplement: Health-Promoting Benefits of Fructooligosaccharides." *Nutrients* 8 (7): 436. https://doi.org/10.3390/nu8070436

Campos, D., I. Betalleluz-Pallardel, R. Chirinos, A. Aguilar-Galvez, G. Noratto, and R. Pedresch. 2012. "Prebiotic Effects of Yacon (*Smallanthus sonchifolius* Poepp. & Endl), a Source of Fructooligosaccharides and Phenolic Compounds with Antioxidant Activity." *Food Chemistry Journal* 135 (3): 1592–1599. https://doi.org/10.1016/j.foodchem.2012.05.088

Carvalho, A. H. O., F. L. de Oliveira, W. L. de Lima, A. T. da Graca, J. L. F. Pedrosa, and M. D. C. Parjara. 2020. "Production and Profitability of Yacon Grown in Different Spatial Arrangement." *Australian Journal of Crop Science* 14 (8): 1214–1220. https://doi.org/10.21475/ajcs.20.14.08.p2158

Choque Delgado, G. T., W. M. da Silva, M. R. Marostica Junior, and G. M. Pastore. 2013. "Yacon (*Smallanthus sonchifolius*): A Functional Food." *Plants for Human Nutrition Journal* 3 (68): 222–228. http://doi.org/10.1007/s11130-013-0362-0

Fernández, E. C., I. Viehmannová, J. Lachman, and L. Milella. 2006. "Yacon [*Smallanthus sonchifolius* (Poeppig & Endlicher) H. Robinson]: A New Crop in the Central Europe." *Plant, Soil and Environment Journal* 52 (12): 564–570. https://doi.org/10.17221/3548-PSE

Goto, K., K. Fukai, J. Hikida, F. Nanjo, and Y. Hara. 1995. "Isolation and Structural Analysis of Oligosaccharides from Yacon (*Polymnia sonchifolia*)." *Biosci. Biotechnol. Biochem.* 59 (12): 2346–2347. https://doi.org/10.1271/bbb.59.2346

Hermann, M., and J. Heller, eds. 1997. *Andean Roots and Tubers: Ahipa, Arracacha, Maca and Yacon*. Promoting the Conservation and Use of Underutilized and Neglected Crops 21. Institute of Plant Genetics & Crop Plant Research and International Plant Genetic Resources Institute. https://www.researchgate.net/publication/244796739_Andean_roots_and_tubers_Ahipa_arracacha_maca_and_yacon

Lachman, J., E. C. Fernández, and M. Orsák. 2003. "Yacon [*Smallanthus sonchifolia* (Poepp. et Endl.) H. Robinson] Chemical Composition and Use: A Review." *Journal of Plant, Soil and Environmental Science* 49 (6): 283–290. https://doi.org/10.17221/4126-PSE

Lachman, J., E. C. Fernández, I. Viehmannová, M. Sulc and P. Cepkova. 2007. "Total Phenolic Content of Yacon (*Smallanthus sonchifolius*) Rhizomes, Leaves, and Roots Affected by Genotypes." *New Zealand of Crop and Horticultural Science* 35 (1): 117–123. https://doi.org/10.1080/01140670709510175

Liu, G., E. H. Simonne, K. T. Morgan, G. J. Hochmuth, S. Agehara, and R. Mylavarapu. 2021. "*Chapter 2. Fertilizer Management for Vegetable Production in Florida.*" *EDIS* 2021 (VPH). https://doi.org/10.32473/edis-cv296-2021

Machado, A. M., N. B. Da Silva, J. B. P. Chaves, and R. D. C. G. Alfenas. 2018. "Consumption of Yacon Flour Improves Body Composition and Intestinal Function in Overweight Adults: A Randomized, Double-Blind, Placebo-Controlled Clinical Trial." *Clin. Nutr.ESPEN* 29:22–29. https://doi.org/10.1016/j.clnesp.2018.12.082

Manrique, I., A. Parraga, and M. Hermann. 2005. "Yacon Syrup: Principles and Processing." *Conservacion y uso de la Biodiversidad de Raices y Tuberculos Andinos: Un decada de investigacion para el desarrollo*, 8B. International Potato Center. https://agris.fao.org/agris-search/search.do?recordID=QP2007000106

Martirosyan, D. M., and J. Singh. 2015. "A New Definition of Functional Food by FFC: What Makes a New Definition Unique?" *Functional Foods in Health and Disease* 5 (6): 209–223. https://doi.org/10.31989/ffhd.v5i6.183

Ojansivu, I., C. L. Ferreira, and S. Salminen. 2011. "Yacon, a New Source of Prebiotic Oligosaccharides with a History of Safe Use." *Trends Food Sci. Technol.* 22 (1): 40–46. https://doi.org/10.1016/j.tifs.2010.11.005

Oliveira, G. O., C. Pereira Braga, and A. A. Henrique Fernandes. 2013. "Improvement of Biochemical Parameters in Type 1 Diabetic Rats after the Roots Aqueous Extract of Yacon [*Smallanthus sonchifolius* (Poepp. & Endl.)] Treatment." *Food and Chemical Toxicology* 59: 256–260. https://doi.org/10.1016/j.fct.2013.05.050

Sanin, A., D. P. Navia, and J. A. Serna-Jimenez. 2020. "Functional Foods from Crops on the Northern Region of the South American Andes: The Importance of Blackberry, Yacon, Acai, Yellow Pitahaya and the Application of Its Biocompounds." *International Journal of Fruit Science* 20 (sup3): S1784–S1804. https://doi.org/10.1080/15538362.2020.1834894

Silva, D. M. N., F. L. de Oliveira, M. A. L. Quaresma, W. A. Erlacher, and T. P. Mendes. 2018. "Yacon Production at Different Planting Seasons and Growing Environments." *Journal of Bioscience* 35 (4): 992–1001. https://doi.org/10.14393/BJ-v35n4a2019-42091

Stephens, J. M., and G. Liu. 2019. "Soil Preparation and Liming for Vegetable Gardens." *EDIS* 2013 (6). https://doi.org/10.32473/edis-vh024-2013

Trinidad, T. P., A. C. Mallillin, R. S. Sagum, and R. R. Encabo. 2010. "Glycemic Index of Commonly Consumed Carbohydrate Foods in the Philippines." *Journal of Functional Foods* 2 (4): 271–274. https://doi.org/10.1016/j.jff.2010.10.002

Tudu, B., P. Barma, B. Patra, S. Baskey, and S. Gurung. 2017. "Pests Spectrum of Yacon (*Smallanthus* spp.: Asteraceae): A Review." *Journal of Agroecology and Natural Resources Management* 4 (3): 224–226. https://www.researchgate.net/publication/321197164_Pests_Spectrum_of_Yacon_Smallanthus_spp_Asteraceae-A_Review

Wagner, M., L. Kamp, S. Graeff-Honninger, and I. Lewandowski. 2019. "Environmental and Economic Performance of Yacon (*Smallanthus sonchifolius*) Cultivated for Fructooligosaccharide Production." *Journal of Sustainability* 11 (17): 4581. https://doi.org/10.3390/su11174581

Watzl, B., S. Girrbach, and M. Roller. 2005. "Inulin, Oligofructose and Immunomodulation." *British Journal of Nutrition* 93 (Suppl. 1): S49–S55. https://doi.org/10.1079/BJN20041357

Yan, M. R., R. Welch, E. C. Rush, X. Xiang, and X. Wang. 2019. "A Sustainable Wholesome Foodstuff: Health Effects and Potential Dietotherapy Applications of Yacon." *Nutrients Journal* 11 (11): 2632. https://doi.org/10.3390/nu11112632