



Stevia

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Introduction

Stevia (*Stevia rebaudiana*) is a small, herbaceous plant in the sunflower family (Asteraceae). It is a perennial in its native South America, but is grown as an annual in all but the warmest areas of the United States. Stevia is commonly called “sweetleaf” or “sugarleaf” because it contains a glycoside in its leaves that imparts a sugary taste. Ground-up stevia leaves, as well as crude leaf extracts, have been used as a natural sweetener all over the world. Stevia products could only be marketed in the U.S. as dietary supplements until 2008, when a U.S. Food and Drug Administration (FDA) no-objection letter cleared the way for the use of some stevia leaf extracts in food products.

Stevia is largely untested in Kentucky, so prospective growers would be wise to proceed very cautiously. Interested producers should start small, planting several different cultivars and/or seed sources in trial plantings. It is advisable to evaluate this crop over several seasons and test-market it before investing much time or money in stevia production. Larger plantings should not be attempted unless the grower has an established market.

Marketing

Growing stevia for bedding plant production is likely the most viable market for Kentucky growers interested in this crop. Greenhouse herb and bedding plant growers could consider adding stevia to their production line. One herb supplier advertises plug trays of stevia that can be ready for resale as 4-inch potted plants in about eight weeks.

Food ingredient manufacturers are refining stevia for use in foods, but



most of that stevia is sourced from South American and Asian growers, especially China. It is extremely difficult for new, untested growers to break into this market. Large-scale growers who have demonstrated success in growing stevia may eventually be able to secure a contract with domestic or foreign buyers. There were no stevia processing plants in the U.S. as of September 2016, according to North Carolina State University; a company purchasing stevia from North Carolina growers ships dried stevia out of the country for processing.

Dried stevia leaves (whole, ground or powdered) are used by some consumers; dried stevia leaves are popular ingredients in some tea blends. Some producers have investigated marketing dried stevia products directly to consumers via farmers markets or internet sales. As of April 2017, whole-leaf stevia and crude stevia extracts do not have FDA approval for use as a food

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additive; whole-leaf and crude stevia are classified only as a food supplement. Producers should always exercise caution when making any health claims about crop products; such claims may not be allowed under food labeling laws and regulations.

Market Outlook

There is a growing interest among homeowners in planting stevia as a summer annual. The greatest potential for stevia production in Kentucky is probably as a potted plant option for herb gardens and landscapes. Stevia's popularity with homeowners is expected to increase as consumers become more aware of the natural sweetening qualities of the plant.

Stevioside, the main sugar compound present in stevia plants, can have a slightly bitter aftertaste. Because individual plants vary in sugar levels and bitterness, the resulting products can also vary considerably. Some manufacturers claim to have developed strains of the stevia plant lacking the unpleasant aftertaste; others have resorted to mixing stevioside extracts with additional natural sweeteners to mask the bitterness. Select plants with high sweetness and no aftertaste to use as mother plants for vegetative propagation.

Another sugar present in stevia, in smaller amounts than stevioside, is rebaudioside-A (trade name rebiana). Rebiana lacks the unfavorable aftertastes attributed to stevioside. In 2008, the FDA issued a "no objection" approval for the Generally Recognized as Safe (GRAS) status of rebiana, thus making the product exempt from the FDA's pre-market approval requirements. The food-supplement-only status of the stevia plant itself, along with its other extracts, remained unchanged.

Rebiana is now used as a beverage sweetener, food ingredient, and is also available under various marketing labels as a table sugar substitute. With an increase in the number of stevia-based products, the need for more stevia farm production could also increase. As indicated above, farm-level stevia production has occurred on minor acreage in the U.S., due to lack of processing facilities.

Production considerations

Site selection and planting

GREENHOUSE-GROWN TRANSPLANTS

Stevia transplants can be produced under similar greenhouse conditions as common flower and

vegetable transplants. Plants can be produced in multi-pack containers or in individual 4- or 6-inch containers. Plants can be produced from seed or cuttings, and small greenhouse producers should consider purchasing plugs from wholesale plug specialists for finishing in larger containers. Vegetatively produced propagules from reliable sources are preferred to ensure production of plants with consistent sugar (glucoside) profiles.

FIELD-GROWN

Stevia prefers well-drained soil rich in organic matter. Do not plant in field sites subject to flooding or puddling, or in saline soils. While plants are somewhat drought-tolerant, a consistent source of moisture should be supplied via trickle irrigation. Most sources recommend frequent, shallow irrigations because stevia's feeder roots tend to be produced near the soil surface. Research in Ontario has shown that stevia has low nutrient requirements, and excess nitrogen can result in profuse plant growth with poor flavor.

Stevia is planted in spring after all danger of frost has passed. Vegetative propagation via tissue culture or rooted cuttings is preferred for obtaining the most consistent results in terms of plant characteristics, but may be cost prohibitive compared to seeds. Stevia can vary in sweetness from plant to plant; therefore, cuttings should be taken only from sources known to have high concentrations of sugar.

Seeds can germinate poorly, so direct-seeding to fields is not recommended; however, plants can be propagated from seed in the greenhouse. Plugs may be purchased from herb wholesalers, or growers could produce their own transplants from high quality seed. Research has shown that only the black or dark seeds are viable, while the clear to tan ones are often sterile. Several seeds should be placed in each plug cell, and then thinned to one seedling per cell once seeds have germinated. Time from seed-to-transplant is approximately seven to eight weeks. An estimated 20,000 to 32,000 plants will be needed for a 1-acre planting. Row spacing of 30 inches with plant spacing of 6 to 7 inches is used in eastern North Carolina.

Pest management

Field-grown stevia is not known to have serious insect pest problems and is often reported as exhibiting insect-repellant qualities. Septoria leaf spot, Southern

blight (*Sclerotium folfsi*), stem and root rot, and tomato spotted wilt virus have been reported in North Carolina. Aphids, thrips, and white flies can become a serious problem on stevia in greenhouses, which could significantly impact transplant production. Research in Kansas indicated that rabbit and deer feeding was not a problem in their stevia plots. The lack of herbicides registered for use with stevia means growers will need to control weeds with alternative methods, such as mechanical cultivation and by hand.

Harvest and storage

Stevia is harvested when plants are mature and blooms have just begun to form, generally in late summer. Sweetness is intensified by cooler temperatures and short days; however, sugar levels decline after flowering. Large-scale commercial growers use a specially designed harvester that cuts the crop at ground level, but small plots are often harvested by hand. It is possible that a rotary mower with a bag attachment could be adapted for plots too large for hand-harvesting, but be sure to use a separate, designated unit to prevent contamination from other crops.

Harvested plants are dried with low heat and good air circulation for 24 to 48 hours. An alfalfa or grain dryer could be used, or plants can be dried in the sun. Dried plants are then threshed to separate the sweet leaves from the bitter stems.

Once dried, leaves can be stored for long periods in air-tight containers or plastic bags. Canadian growers store the dried leaves in sealed, plastic-lined boxes prior to processing. Home processing generally involves either crushing the ground leaves or making a crude extract using a water extraction process. Commercial processing to isolate pure rebaudioside-A for the various sugar substitutes on the market involves a much more complicated procedure. Some of these extraction processes are patented.

Labor requirements

Potential labor needs for field-produced stevia will be highly variable depending on market channel and product marketed. Hand planting, harvest, and packing products for retail would make stevia a labor-intensive crop, similar to culinary herb crops that are dried and packaged. Stevia grown for bedding plant production would have similar labor requirements

as other annuals that are planted, transplanted and harvested for sale as bedding plants.

Economic considerations

Initial investments for greenhouse-produced transplants are consistent with other greenhouse-produced bedding plants. When produced as an additional transplant species within an existing product mix, average production costs are approximately \$1.50 per square foot of greenhouse space. North Carolina stevia growers try to get three to five years of production per planting, because setting a new field on an annual basis has not proved to be economically feasible given current crop prices. However, stevia has not overwintered reliably in western North Carolina, where only about 17 percent of the crop survived the winter. Growers in eastern North Carolina have been more successful in overwintering stevia. How well stevia would overwinter in Kentucky is unknown.

Initial investments for field-produced plants include land preparation, purchase of seed or transplants, and installation of an irrigation system. Additional costs for a minor niche crop like stevia may include product and market development, advertising and consumer education. Researchers evaluating field production of stevia in North Carolina have noted that herbicide approvals for stevia are needed to reduce the costs of mechanical cultivation and hand hoeing for weed control.

Wholesale and retail prices for stevia are highly variable, and this price instability indicates that stevia is still an emerging and experimental new crop. It is likely that stevia, when grown in a 1-acre mix of other edibles and bedding plants, could help generate returns to land, labor and management similar to culinary herb production. Producers should never plant a new niche crop without a well-defined plan for marketing and selling their crop.

Selected Resources

- Exploring Stevia for Western North Carolina (North Carolina State University, 2015) <https://newcropsorganics.ces.ncsu.edu/herb/stevia/>
- Stevia Production in North Carolina (North Carolina State University, 2013) <https://cefs.ncsu.edu/wp-content/uploads/Stevia-FAQ.pdf?3106e7>
- Evaluating Stevia Production (North Carolina

State University, 2015) <https://craven.ces.ncsu.edu/evaluating-stevia-production/>

- What's Happening on the Farm: Stevia Research (N.C. Department of Agriculture and Consumer Services blog In The Field, 2016) <http://info.ncagr.gov/blog/2016/09/12/whats-happening-on-the-farm-stevia-research/>
- First Report of Stem and Root Rot of Stevia Caused by *Sclerotium rolfsii* in North Carolina (Plant Disease, 2014) <http://apsjournals.apsnet.org/doi/abs/10.1094/PDIS-12-13-1238-PDN>
- First Report of Tomato spotted wilt virus in Stevia *rebaudiana* in North Carolina (Plant Disease, 2016). <http://apsjournals.apsnet.org/doi/full/10.1094/PDIS-11-15-1367-PDN>
- Many Questions Surround Stevia Production in North Carolina (Southeast FarmPress, 2014) <http://southeastfarmpress.com/miscellaneous/many-questions-surround-stevia-production-north-carolina>

- The Cultivation of Stevia, Nature's Sweetener (Ministry of Agriculture Food and Rural Affairs, Ontario, Canada, reviewed 2010) <http://www.omafra.gov.on.ca/english/crops/facts/stevia.htm>
- Grower's Guide: Stevia (Kansas State University, 2004) <http://www.ksre.ksu.edu/bookstore/pubs/mf2630.pdf>
- Stevia (University of Nebraska, 2014) <http://extensionpublications.unl.edu/assets/pdf/g1634.pdf>

Suggested Citation:

Kaiser, C. and M. Ernst. (2017). *Stevia*. CCD-CP-55. Lexington, KY: Center for Crop Diversification, University of Kentucky College of Agriculture, Food and Environment. Available: <http://www.uky.edu/ccd/sites/www.uky.edu/ccd/files/stevia.pdf>

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August 2017

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