



An Overview of Florida Sugarcane¹

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Sugarcane is a crop that can be grown throughout Florida. In many areas of the state, sugarcane is grown only as a hobby crop for syrup production or as a source of "chewing cane." However, in South Florida, near Lake Okeechobee, sugarcane is grown commercially for the production of crystal or "white" sugar.

This overview was prepared to answer the most frequently asked questions about the commercial Florida sugarcane industry and to describe the production of sugarcane and sugar.

What is sugarcane?

Sugarcane is a tropical grass native to Asia, where sugarcane has been grown in gardens for more than 4,000 years. The product of interbreeding four species of the *Saccharum* genus, sugarcane is a giant, robust, sugary plant.

Methods for manufacturing sugar from sugarcane were developed in India about 400 BC. Christopher Columbus brought the plant to the West Indies in the sixteenth century, and today sugarcane

is cultivated in tropical and sub-tropical regions throughout the world. Roughly 75 percent of the world's sugar comes from sugarcane.

Where is sugarcane grown in Florida?

Palm Beach County accounts for approximately 75 percent of the commercial sugarcane acreage in Florida and 75 percent of the total harvested sugarcane tonnage in Florida. The remainder of Florida's commercially produced sugarcane is grown in Hendry, Glades, and Martin counties. These counties—along with Palm Beach County—are all adjacent to Lake Okeechobee, which is the northernmost portion of the historic Florida Everglades system. This area of commercial sugarcane production is so compact, most visitors to the Sunshine State never see a commercial sugarcane field.

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Figure 1. An aerial view of commercial sugarcane fields near Belle Glade, FL, June 2008. In the foreground are variety test plots managed by sugarcane growers for the purpose of evaluating promising germplasm lines, a process required for the release of new cultivars. Credits: James M. Shine, Jr., Sugar Cane Growers Cooperative of Florida

With renewed interest in the possibility of growing sugarcane as a source of biofuel for ethanol, small amounts of sugarcane are also being grown on a demonstration basis in some counties that neighbor this region of commercial sugarcane production in Florida.

Why is sugarcane grown near Lake Okeechobee?

Fertile organic soil and the warming influence of Lake Okeechobee are the primary reasons Florida's sugar industry originally located in this region. Killing cold temperatures occur very infrequently near the lake. Adequate water and abundant sunshine were also important factors that led to the location of Florida's commercial sugarcane industry in this region. The expensive proposition of establishing any new infrastructure has ensured that commercial sugarcane production in Florida remains fairly close to the existing sugar mills.

Is South Florida a good place to grow sugarcane?

Fair. The muck soils of the Everglades are rich in nitrogen and support vigorous cane growth. Nitrogen-rich soils, in combination with the favorable South Florida climate, can sometimes lead

to excessive sugarcane growth, which results in large stalks, but with reduced sugar content.

Sporadic sub-freezing temperature conditions damage some cane almost every winter, particularly young growth from newly planted cane or young re-growth from ratoon “stubble” crops. South Florida also has its share of environmental concerns, thus growers design and implement Best Management Practices (BMP's), which typically increases production costs.

While Florida sugar mills are modern and efficient, labor costs are extremely high by global standards. Underlying high labor costs and other economic factors led to the industry's rapid conversion to mechanical harvesting in the early 1990s and ultimately to a reduction in the number of sugar mills.

How much sugarcane is grown in Florida?

In recent years commercial sugarcane production in Florida has declined slightly. Sugarcane acreage has decreased from a high of 454,400 acres (183,727 hectares) in the 2000-2001 crop year to approximately 400,000 acres (161,874 hectares) for the 2008-2009 crop year. Florida's 2000-2001 sugarcane crop year yielded over 17.3 million U.S. tons (15.7 million metric tons) of stalks and 2.02 million U.S. tons (1.83 million metric tons) of raw sugar. In comparison, Florida's 2007-2008 sugarcane crop year yielded 13.3 million U.S. tons (12.1 million metric tons) of stalks and 1.55 million U.S. tons (1.41 million metric tons) of raw sugar.

Placing the current size of Florida's sugarcane crop into perspective historically, prior to the Cuban embargo in 1961, Florida had only 50,000 acres (20,234 hectares) of sugarcane.

What is the value of Florida's sugar crop?

In Florida's sugarcane industry, recoverable sugar, by weight, has increased from below 10 percent in 1984 to 11.6 percent in 2000-01. In 2008 Florida's raw sugar crop was valued at approximately

\$450 million.

(<http://www.ers.usda.gov/StateFacts/FL.htm>).

Most of the fibrous portion of the cane stalks (bagasse) is burned as fuel for the mills, saving sugar producers an estimated 113 million gallons of fuel oil or 2.1 billion kilowatt hours of electricity.

Sugarcane is Florida's most economically valuable field crop, worth more than the combined value of Florida-grown corn, soybean, tobacco, and peanut crops. In 2004 sugarcane ranked third in Florida's agricultural economy; by 2008 sugarcane had fallen to sixth in the state's overall agricultural economy.



Figure 2. Raw sugar, produced from Florida-grown sugarcane, in temporary storage in a warehouse in South Florida, March 1998. In the sugar-production process, raw sugar is moved from warehouse to refinery, where the sugar is re-dissolved and refined to obtain the purity required for white sugar crystals. Credits: Sugar Cane Growers Cooperative of Florida

What is Florida's contribution to the U.S. production of sugar?

In 2007-08, Florida contributed an estimated 48 percent of the cane sugar and 24.3 percent of the total (from sugarcane and beets, combined) sugar produced in the United States.

Where does the rest of the sugar produced in the U.S. come from?

Florida is the largest producer of sugarcane in the United States followed by Louisiana, Hawaii, and Texas in order of production. Sugar beets are grown

in Minnesota, North Dakota, Idaho, Michigan, California, and in six other states. The sugar beet industry provides approximately 50 percent of the sugar produced in the United States, and sugarcane production accounts for the remaining 50 percent of domestic sugar production.

All U.S. sugar production combined still falls short of U.S. consumption. As a result, almost one-fifth of the sugar consumed in the United States is imported.

What research facilities support the Florida sugarcane industry?

Production of improved varieties is the primary mission of the U.S. Department of Agriculture-Agricultural Research Service (USDA-ARS) Sugarcane Field Station at Canal Point, Fla. Originally established to produce seed for the Louisiana sugarcane industry, this station now has an extensive program for developing and testing sugarcane varieties adapted to Florida conditions. High sugar content, disease resistance, rapid growth, and tolerance to high water tables are among the traits sought in new sugarcane varieties. Additionally, a new focus of the variety development program is aimed at improving yields of sugarcane grown on sandy mineral soils.

In Palm Beach County, the University of Florida Everglades Research and Education Center at Belle Glade, Fla. (EREC) cooperates with the USDA-ARS at Canal Point in a sugarcane variety development program and conducts research on sugarcane nutrition and physiology, pest control, water use, and associated agronomic problems. In Immokalee, Fla., in Collier County, on Florida's west coast, the University of Florida Southwest Florida Research and Education Center (SWFREC) conducts research to meet the needs of sugarcane producers who plant on the sandy mineral soils of that region. Research results and recommendations (fertilization, weed control, etc.) are presented in reports and meetings sponsored by the University of Florida Cooperative Extension Service.

Major sugarcane companies – including the United States Sugar Corporation, Florida Crystals Corporation, and the Sugar Cane Growers

Cooperative of Florida – conduct their own research and also support research programs at University of Florida (UF) and USDA facilities.



Figure 3. Sugarcane cultivar 'CP 00-1101' with lower leaves stripped away to reveal the segmented physiology of sugarcane stalks, August 2007. Credits: Wayne Davidson, Florida Sugar Cane League.

How is sugarcane planted?

Sugarcane planting takes place from late August through January. Because sugarcane is a multi-species hybrid, sugarcane seeds will produce plants that differ genetically from the parents. For this reason, commercial planting of sugarcane using seeds is impractical. Instead, a favorable sugarcane variety is planted by using sections of stalks from the mother plant, which then sprout daughter plants (clones), which are genetically identical to the mother plant variety. This process is called vegetative propagation.

Concerns surrounding high labor costs have supported a growing interest in developing machinery and agronomic practices for the mechanical planting of sugarcane. However, as of 2008, hand planting is still a common practice for planting sugarcane.

In this scenario, portions of mature sugarcane fields are reserved for “seed cane” (the cane used to vegetatively propagate the next planted crop). Instead of this sugarcane being mechanically harvested for the sugar mill, stalks of seed cane are mechanically harvested by “whole stalk harvesters”, loaded onto wagons, transported to the target field, and dropped horizontally into shallow furrows roughly 3-8 inches deep (8-20 cm deep). Typically, these sugarcane stalks are dropped as pairs, for a double line of sugarcane stalks throughout the furrow. To increase sprouting potential, stalks are then cut into shorter segments before being covered with soil.

Conventional row spacing for commercial sugarcane production in Florida is 5 feet (1.5 m). Cane stalks have buds (“eyes”) every 2-6 inches (5-15 cm), and each of these buds have the capability to sprout rapidly when buried in moist soil. Within two to three weeks, shoots emerge and, under favorable conditions, produce secondary shoots to give a dense stand of cane.

How often is a cane field replanted?

Typically, a sugarcane field is replanted every two to four years. After a field has been harvested the first time, it is maintained free of weeds, and a second crop of stalks, called a ratoon, grows from the old plant stubble. The second crop is harvested about one year after the first harvest. On average, 3 annual crops are harvested from one field before the field is replanted. When annual production declines to an unacceptable level due to insect, disease, or mechanical damage, the old sugarcane crop is plowed under after harvest, and the land is prepared for replanting with new seed cane.

If the last harvest of the ratoon sugarcane crop occurs early enough during the harvest season (possibly before January), the field will likely be replanted to sugarcane (termed “successive planting”). If, however, the last harvest of the ratoon crop occurs later, a decision may be made to delay replanting in sugarcane until the following season. Instead, the fallow sugarcane field may be planted to another crop, such as rice or sweet corn (termed, “fallow planting”).

Doesn't sugarcane produce seed?

A sugarcane plant is capable of producing seed, but seeds are not used for commercial planting. Sugarcane seeds are so small (1,000 seeds per gram or almost 454,000 seeds per pound), they cannot be planted directly in the field. Furthermore, sugarcane does not breed true. As a result, seeds from a single plant will produce seedlings that are genetically different from each other. Thus, seeds are not used for planting since varietal uniformity is important for commercial sugarcane production. Finally, only under strictly controlled temperature and day-length conditions will sugarcane seed be viable. Under normal conditions in Florida, sugarcane seed produced in the field will not germinate. For these reasons, only stalks are used as planting material for the vegetative propagation of sugarcane.

What are the white or reddish plumes seen in some sugarcane fields during winter and spring?

Plumes are the flowers and seed heads of the sugarcane plant. Each plume consists of several thousand tiny flowers. Each flower is capable of producing one seed. The cool winter weather in Florida ordinarily prevents development of viable seeds. During breeding for variety development, special precautions are taken to produce viable seed.

What attention does a cane field require after planting?

After sugarcane planting, weeds are controlled through cultivation and herbicides. Water must be



Figure 4. Sugarcane flowers, which produce seeds, are pictured in this November 2001 photo. Because seeds from a single sugarcane flower differ genetically, pieces of sugarcane stalk are planted, rather than seeds, to produce new plants that are genetically identical to the parent plant. Credits: James M. Shine, Jr., Sugar Cane Growers Cooperative of Florida

pumped out of the field when rainfall is excessive. When the soil gets too dry, the crop is irrigated by allowing the water to flow back into the ditches that are normally used for drainage. Water readily seeps from the lateral field ditches throughout the entire sugarcane field, flowing on top of the underlying limestone bedrock and irrigating the porous organic muck soils. Sugarcane grown on nutrient-poor sand soils will require supplemental fertilizer applications to achieve optimal growth.

When and how is the cane harvested?

Sugarcane is harvested from late-October through mid-April. Given no damaging effects from freezes, sugar yields are typically highest after December. However, to complete the entire South Florida sugarcane harvest within the optimal time period, some fields must be harvested before sugarcane plants have reached maximum yield

potential. For this reason, agronomic research that documents variety-specific sugar yields over time is a useful tool for identifying varieties that can best be harvested in early-, mid-, and late-season. (For more on this topic, see EDIS Publication SSAGR221, *Maturity Curves and Harvest Schedule Recommendations for CP Sugarcane Varieties*, <http://edis.ifas.ufl.edu/SC069>.)



Figure 5. Cattle Egrets (*Bubulcus ibis*) forage for insects and soil grubs during a pause in a sugarcane harvest operation in fields west of Clewiston, FL, December 2005. Credits: Ronald W. Rice, IFAS/UF

In years past, sugarcane was hand-harvested, using cane knives. Conversion to mechanical harvesting began in the mid-1980s, and by 1993 the entire South Florida sugarcane crop was harvested mechanically.

Why are sugarcane fields burned before harvest?

Controlled fires in sugarcane fields burn off dead leaves and other biomass “trash,” which would otherwise impede the harvest operation, increase transportation costs to the mill, interfere with milling machinery, and absorb sugar during the extraction process. (Absorbed sugar cannot be recovered.)

Fields are burned immediately before harvest. The fires are rather spectacular, but of short duration; a 40-acre field burns in 15-20 minutes. Burning is

done only in the daytime (through a permitting process with the Florida Division of Forestry), and only when dispersal of the smoke by air currents causes minimum nuisance.

Once the cane is cut, how does it get to the mill?

After the sugarcane fields are burned, mechanical harvesters deposit the cut cane directly into field wagons. Four-wheel drive tractors haul 16 tons of cane out of the field with each four-wagon load. At special ramps near the field, the cane is dumped from the wagon into highway trailers or rail cars for transport to the mills. Rail cars carry 25-30 tons each. Highway trailers carry 20 tons per load.

How is the Florida sugar industry organized?

All commercially produced Florida sugarcane is destined for one of four sugarcane mills in South Florida. Corporations that grow their own sugarcane and extract the sugar in their own mills produce more than 65 percent of the cane. Independent growers for grower-owned cooperative mills produce another large portion, 25-30 percent. The remaining cane is grown by independent producers and sold to one of the four mills in South Florida.

What happens to the cane at the mills?

At the mill, the sugarcane is crushed between heavy rollers to squeeze out the juice. Small amounts of hot water are then added, and the fiber is again squeezed to remove as much juice as possible. This process is repeated several more times to maximize sugar extraction from the crushed cane stalks.

Lime is then added to the juice to help filter out cane fibers and soil particles and to prevent conversion of the desirable sugar (sucrose) into other sugar forms that won't crystallize. This sucrose solution is concentrated by evaporating off the water (which is also recovered and reused by the mill) until raw sugar crystals form.

For each pound of sugar produced, 6.5 pounds or 3 quarts of water must be boiled off. Because sugarcane is more than 50 percent water when harvested, enough water is recovered during sugarcane processing that sugar mills actually become producers of water, rather than consumers. Most of what appears as "smoke" emitted from sugar mills is actually water vapor, steam generated from boilers in the mill.

Raw sugar is a coarse, brownish material containing impurities that must be removed in a separate refining process.

What is bagasse? ("baa-gas")

Bagasse is fibrous plant material that remains once all of the juice has been squeezed from the sugarcane stalk. Bagasse consists mostly of stalk fibers, but also contains leaves and other biomass components inadvertently brought to the mill by harvest trucks or railcars. Bagasse is about half water and half dry matter (plant material).

In Florida, most bagasse is burned as fuel for the mills. Some of the mills also burn excess bagasse to generate electricity for the public grid.

What is blackstrap molasses?

Blackstrap molasses is the dark, viscous liquid that remains when as much sucrose as practical has been removed as sugar crystals from boiled cane juice. Blackstrap molasses is used primarily as animal feed.

What is done with the raw sugar?

Raw sugar is stored in high piles in large warehouses to await shipment to a refinery. Having the consistency of very coarse sand, raw sugar is moved by belt conveyors, front-end loaders, or dump

trucks to be loaded into large dump trucks, railcars, barges, or ships for transportation to refineries.

Are there sugar refineries in Florida?

Yes. Two refineries in South Florida produce both granulated sugar and liquid sugar. About 65 percent of the raw sugar produced in Florida is processed in these refineries. One refinery is in South Bay, Fla. and the other refinery is in Clewiston, Fla.

The granulated sugar is packaged in consumer-size bags. Liquid sugar is shipped in tanker trucks for use in beverages, processed foods, and bakery goods.

Can members of the public visit commercial sugar mills and refineries in Florida?

Sugarcane milling is an industrial process and, as such, is dusty, noisy, and potentially dangerous to non-trained personnel. However, special interest group tours are available during the milling season at selected mills. Tours must be arranged in advance.

How much sugar is there in one stalk of Florida sugarcane?

An average sugarcane stalk weighs about 3 pounds (1.4 kilograms) and is roughly 85 percent liquid. An average stalk, therefore, has about 2.6 pounds (1.2 kilograms) of juice, which is roughly 11 percent sugar by weight. Thus, an average stalk contains about 0.3 pounds (0.14 kilograms) of sugar.

Which is better, cane sugar or beet sugar?

Cane sugar and beet sugar are identical in chemistry and quality. Sugar beets, which provide roughly 25 percent of the world's sugar, are grown in temperate areas. Sugarcane is grown primarily in the tropics and sub-tropics.

How much sugarcane is required to supply one American with sugar for one year?

In 2008 the average refined sucrose sugar consumption in the United States was approximately 66.3 lbs. per person per year. This total could be produced from roughly 221 stalks of sugarcane. At 30,000 stalks per acre, one acre would supply sugar for roughly 137 Americans for a year.

In 2004, per capita consumption in the United States was 61.5 pounds of refined sugar, 78.1 pounds of corn-derived sweeteners, and 1.3 pounds of honey and edible syrups, for an annual total caloric-sweetener consumption of roughly 141.0 pounds. By 2008 per capita sugar consumption had increased slightly to 66.3 pounds while per capita use of corn-derived sweeteners had dropped slightly to 69.3 pounds.

<http://www.ers.usda.gov/Briefing/Sugar/data/table50.xls>

Per capita sugar consumption has decreased from about 100 pounds in the early 1970s to 66.3 pounds in 2008. Consumption of high fructose corn syrup (HFCS) has increased from two pounds per capita in the early 1970s to 69.3 pounds in 2008.

What determines the price of sugar?

Neither Florida nor the United States exports sugar, so changes in the Florida crop have little effect on world sugar prices. Worldwide, individual government tariffs and trade policies play a paramount role in determining sugar prices.

World demand for sugar is rather constant and, under normal growing conditions, production of sugar matches the demand, resulting in stable prices for raw sugar. However, good growing conditions sometimes result in higher-than-normal sugar yields in the major sugar beet and sugarcane producing areas of the world – Brazil, India, and the European Union.

When surplus quantities of sugar enter the world market, surplus sugar can be purchased well below the normal market price. However, to prevent unpredictable disruptions to the U.S. sugar industry,

the federal government annually adjusts import quotas on foreign sugar. These quotas help insulate U.S. consumers, as well as sugar producers, from the sometimes rapidly fluctuating sugar prices on the world market.