PRECISION AGRICULTURE IN COLOMBIAN SUGAR CANE

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While Colombia is better known for coffee and coca, sugar cane is one of its primary crops, and most of it is grown in the Cauca Valley, a rich, mostly flat agricultural valley that bisects the country from south to north. Sugar cane producers here are utilizing many of the latest tools to produce exceptionally high yields of sugar. But due to the unique characteristics of how this crop is produced, there is not widespread adoption of site-specific technologies—exemplifying the often-said statement that site-specific technologies are indeed "site specific," as related to use on crops, within certain geographies, and from farm to farm.

Sugar cane has been grown in Colombia since introduced by the Europeans, but now Colombia produces some of the highest yields in the world. Today there are about 200,000 ha of sugar cane in the Cauca Valley, planting and harvesting occurs year around, and yields exceeding 130 tons/ha are common.

One of the reasons why site-specific technologies have not been widely adopted in sugar cane is that there is not currently a commercial yield monitor being used in Colombia—denying producers the opportunity to see any potential payoffs of site-specific management. A prototype monitor is being tested by Cenicaña, the producer/mill funded organization, but currently there is no practical way to quantify yields. Much of the harvest is still done by hand, a reasonable approach when field laborers can be hired for about $1/hour. Ironically collecting site-specific yield information is more feasible with hand harvesting—some growers have weighed the cut stems as they are machine gathered to get some idea of field spatial variability.

An aspect of site-specific agriculture that has broad appeal is in the variable application of crop inputs—putting precise amounts in each portion of a field according to need, not broadcast uniformly over non-uniform fields. The soils in the Cauca Valley are alluvial soils, variable in their nature, but appear relatively uniform, giving at least the perception of a modest amount of

Three forms of precision herbicide weed control being used on the same Colombian farm. From left, whole fields are treated with workers utilizing backpack sprayers; ATVs are used in lieu of larger equipment due to ground unevenness from tilling compacted soil; Tractor-mounted weed sensor technology being used under a hooded sprayer to increase the efficiency of between-row weed control.

within-field variability. Many of these fields have had one crop—sugar cane—grown continuously and treated uniformly for decades. Land in the valley is not cheap—currently land is selling for $10,000-20,000/ha or more, doubling in price just in the last few years, so increases in the value of this crop could drive more site-specific applications in the future. Also, the Colombian government is becoming increasingly strict in environmental protection, so there may be additional incentives forthcoming there.

Machine sugar cane harvest is done one row at a time, accompanied by heavy equipment.

Soil compaction is an extreme problem in Colombian sugar cane production. Freshly harvested cane cannot be stored for any length of time, and contracts with the mills require delivery when it is needed, so fields are frequently harvested when soils are wet and not otherwise suitable for traffic. Annual rainfall in the sugar cane areas of the valley is similar to that of the Eastern Corn Belt. Mechanical harvesters there cover one row at a time, and work in tandem with wagons traversing the fields that when full may contain 20 tons of cane. The logical solution in other crops and management systems is controlled trafficking using guidance, but the one-row-at-a-time system in cane is not well adapted to this.

Deep tillage is the Colombian farmer's remedy to compacted soils, but this creates additional problems as well—by bringing up huge chunks of soil that leave field surfaces irregular. This uneven field surface makes the use of large-scale fertilizer and pesticide application difficult—thus, many crop inputs are applied manually, or with all-terrain vehicles (ATV's).

The use of guidance systems to reduce skips and overlaps in field operations is less important in sugar cane as compared to other crops. Sugar cane is a perennial so fields are harvested several times from the same planting (ratoon), and field operations follow established rows. A possible use of guidance is for harvesting to stay on rows to reduce damage to the crowns. It is often difficult for the harvester operators to stay on the rows, or sometimes to even see the rows—and harvest often occurs through the night as well, with many operations employing three crews that rotate to operate day and night.

Sugar cane field near Palmira, Colombia showing visual variability (Google Earth).

With a plant where the above-ground biomass is so directly related to production, and a crop that gets tall and nearly impossible to scout on foot, remote sensing might certainly have some possibilities. Some possible uses for remote sensing include the identification of missing plants where stands have been thinned due to tillage or harvesting damage, disease or insect detection, in forecasting production, or in irrigation scheduling. Half of Colombian sugar cane production expenditures are for irrigation water.

Where the Colombians have excelled in precision technologies is in their collective use of GIS systems for recordkeeping and data mining. When farmers sell sugar cane, 0.55% of the value of the crop goes to Cenicaña to fund sugar cane research and outreach programs. Cenicaña is well regarded by the growers and the mills, and information is freely shared in both directions. Records for nearly every sugar cane field in the valley are kept by Cenicaña, which can source this information to judge the impact of varieties, planting and harvesting dates and methods, fertilization, and the like. This information is kept in a web-accessible database for query and interpretation by member growers and mills.

Sugar prices are at 20-year highs, and sugar cane is a relatively efficient source for ethanol production. Fermentation and distillation facilities are being built next to existing mills to capitalize on this, where the sugary juice is piped to the adjacent ethanol facility. Projected world energy demands are causing the growers, mills, and associated industries to feel upbeat about Colombia's well–established sugar industry.

In summary, sugar cane growers continue to seek ways to reduce costs, increase productivity and sugar yields, but few site-specific technologies have been feasible in their current production system. Continued high demand for sugar and its products, the development of a workable yield monitor, environmental regulations, and modifications in tillage and harvesting equipment could trigger new ways of incorporating precision technologies into Colombian sugar cane production.

For more information:

Tecnicaña, the Association of Colombian Sugar Cane Technologists
http://www.tecnicana.com/html/sitio/index.php

Cenicaña, The Colombian Sugar Cane Research Organization http://www.cenicana.org/