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Notes on the Use of Remote Sensing in Sugarcane

The development of earth observation systems has provided scientists and researchers, with new sources of information in different scientific fields as oceanography, meteorology and agriculture. Within these systems, technologies known as remote sensing have called the attention of the scientific community due to its capability of providing large amounts of updated information in a regular basis and with relative precision. Agronomic systems of sugar industries around the world, regard these technologies as useful tools with a high development potential, especially in processes related to sugarcane management. Sugarcane producers, like Australia and South Africa, have been pioneers in the use of remote sensing for research purposes. Applications related to mapping and classification of sugarcane, variety identification and yield estimation have been evaluated in these countries since 1990, and in recent years in other countries like USA, Brazil and Colombia.

An interesting literature review conducted by Abdel-Rahman and Ahmed (2008), summarizes the progress in the application of remote sensing in the sugarcane crop. The paper aims at identifying potentialities and limitations of using remote sensing and vegetation indices for monitoring the crop in the applications mentioned in the paragraph above.

In the case of mapping and classification of sugarcane (for monitoring the expansion of cultivated areas), the authors mention that classifications made with LANDSAT TM and LANDSAT ETM+ have shown results with accuracy greater than 90%. More specific studies showed the capacity of sensors like SPOT 4 to monitor harvests. There are other studies made with products from sensors as MODIS, which despite their low spatial resolution, are widely used due to its high temporal resolution (daily). This temporal resolution contrasts with the low temporal resolution of products from LANDSAT (16 days) and SPOT 4 (26 days). Disaggregation techniques have been already used in studies of vegetation in order to combine the products of the two sensors to obtain a product with high spatial resolution (detail) and high temporal resolution (frequency). An evaluation of these techniques in sugarcane could be carried out in order to improve the performance of both products.

The identification of varieties is another application addressed by the authors of this article. It cites a study which, using LANDSAT images and vegetation indices, obtained results with over 90% accuracy identifying varieties. Another study carried out in Colombia showed positive results using LANDSAT ETM+ products and statistical techniques of spectral discrimination. Similar studies carried out in Australia, Brazil and the U.S. have also shown high degree of accuracy identifying varieties using hyperspectral sensor data. Techniques of identification of spectral bands sensitive to changes in chlorophyll content, water content and lignin-cellulose were also used in these studies with hyperspectral data. In the identification of varieties, the spectral resolution plays an important role according to the varietal composition of the sugarcane production system. Systems with a low varietal composition can benefit from the use of LANDSAT products, assuming that the varieties have marked phenotypic differences detectable within the bands of the sensor or through the use of vegetation indices. In contrast, systems of high varietal composition with similar phenotypes will required products as the hyperspectral sensor EO-1 Hyperion, for the identification of bands sensitive to small differences in pigmentation, water content or others.

In the sugarcane industries around the world, one of the remote sensing applications for sugarcane that aroused great interest is the estimation of yields. According to the authors, studies carried out with products LANDSAT TM and LANDSAT ETM+ showed promising results when combined with simulation models and vegetation indices such as the normalized difference vegetation index (NDVI) and enhanced vegetation index (EVI). Other studies using sensors as ASTER or NOAA-AVHRR, also showed promising results at mill level, but have problems when trying to estimate the production at plot level. The use of images with better spatial resolution would help to improve the performance of the models for the estimation at plot level. However, it is important to consider that the costs of the acquisition of these products increase significantly compared to products such as LANDSAT or MODIS. Another opportunity of improvement and potential source of information derived from satellite imagery is estimating biophysical variables of sugarcane, such as leaf area index (LAI) and photosynthetically active radiation (FPAR). The monitoring of these variables could substantially increase the quality of the results and improve yields estimates using simulation models.

In conclusion, the remote sensors have a high potential of use in sugarcane agricultural systems. The ability to provide updated information on a regular basis allows their use in monitoring systems. The development of new sensors with higher spatial, temporal or spectral resolutions can greatly benefit sugar industries. However, the cost of these new technologies is still high, thus their acquisition and use is limited to a few producers. Given these conditions, investment in research to determine the most appropriate products and techniques for each application should be the path to follow.

References

Abdel-Rahman, E.M. and Ahmend, F.B. 2008. 'The application of remote sensing techniques to sugarcane (*Saccharum spp.* hybrid) production: a review of the literature.' International Journal of Remote Sensing, vol. 29, no. 13, pp. 3753-3767.