THE MOST SENSITIVE GROWTH STAGE TO QUANTIFY NITROGEN STRESS IN SUGARCANE USING ACTIVE CROP CANOPY SENSOR

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ABSTRACT

The use of sensors that allow the application of nitrogen fertilizer at variable rate has been widely used by researchers in many agricultural crops, but without success in sugarcane, probably due to the difficulty of diagnosing the nutritional status of the crop for nitrogen (N). Active crop canopy sensors are based on the principle that the spectral reflectance curve of the leaves are modified by N level. Researchers in USA indicated that corn N stress in-season can be detected using a crop canopy sensor and N rate algorithms were developed to make in-season N rate applications. The objective of this study was to evaluate the nutritional status of sugarcane, fertilized with different nitrogen rate applied at different periods after harvest, using a crop canopy sensor in order to generate parameters to establish the most sensitive growth stage to detect N deficiency in order to guide N application. The experiment was installed in a commercial area of sugarcane (first ratoon). The experimental design was randomized blocks in 5x5 factorial with four replications, with five nitrogen rates applied at five different periods after sugarcane harvest. During the crop growing, its N nutritional status was assessed through leaf laboratory analysis and the results compared with canopy reflectance reading using an active optical sensor. In all evaluation periods, crop biometric parameters were measured. Pearson's correlation shows that the vegetation index presented the highest correlation with tiller height and the number of tillers when evaluated, indicating that the most appropriate period for use of active optical sensor in the field to predict N deficiency in sugarcane is when the average height 0.20 m with 16-20 tillers m^{-1}.

Keywords: Active Optic Sensor; *Saccharum spp*.; Nitrogen Fertilization;

INTRODUCTION

N fertilizer use efficiency in sugarcane can be improved if it is applied at variable rate as it is done in other crops. Today the problem for the Brazilian sugarcane farmers is how to identify the best crop stage to apply N fertilizer and determine the correct amount (MOLIN et al., 2010). Canopy reflectance sensor can be used for this propose trough NDVI determination if a correlation is established between this index and the nutritional deficiency of the crop. Therefore, the objective of this study was to evaluate the nutritional status of sugarcane, fertilized with different nitrogen rate applied at different periods after harvest, using a crop canopy sensor in order to generate parameters to establish the most sensitive growth stage to detect N deficiency in order to guide N application.

MATERIAL AND METHODS

The experiment was installed in a commercial area of sugarcane (first ratoon), cultivated with the variety IACSP95-5000. The experimental design was randomized blocks in 5x5 factorial with four replications, five nitrogen rates (0, 50, 100, 150 and 200 kg ha^{-1} N) applied at five different periods after sugarcane harvest (immediately after harvest, 30, 60, 90 and 120 days after the harvest - DAH). During the crop growing (30, 60, 90, 120 and 150 DAH) the N nutritional status of the crop was assessed through leaf laboratory analysis and the results compared with canopy reflectance reading using an active optical canopy sensor (ACS-430, Holland Scientific Crop Circle, Lincoln, NE, USA). In all evaluation periods, we measured crop biometric parameters (tillers m^{-1}, height and diameter of tillers). The height of tillers was measured from ground level soil to the insertion of the leaf +1 (Top Visible Dewlap - TVD).

RESULTS

Pearson's correlation shows that the NDVI presented the highest correlation with number of tillers (r = 0.63 - average 20 tillers m^{-1}) - Table 1, and the tiller height (r = 0.46 – average 0.194 m) - Table 2, when evaluated at 90 DAH. This indicate that the most appropriate period for use of canopy sensor in the field to predict N deficiency in sugarcane is around 90 DAH with 16-20 tillers m^{-1} and average height 0.20 m.

Amaral (2014) evaluating the use of canopy optic active reflectance sensors in nitrogen application on sugarcane, concluded that the sensor is able to predict the nitrogen rate for plants of sugarcane, especially when these are in early stage (budding of ratoon), with a height tillers between 0.4 to 0.7m. However, these values of tiller height depending that the variety, harvest time and weather conditions occurring in the field.

Table 1. Pearson´s correlation for the NDVI x number of tillers according to nitrogen application time and period evaluation.

Nitrogen	NDVI x Number of Tillers				
Application	30	60	90	120	150
0	-0.20	0.44	0.63	0.52	0.13
30		0.31	0.56	0.35	0.41
60			0.52	0.51	0.38
90				0.37	0.38
120					0.41

Table 2. Pearson´s correlation for the NDVI x tiller height according to nitrogen application time and period evaluation.

Nitrogen	NDVI x Tiller Height				
Application	30	60	90	120	150
0	0.30	-0.15	0.46	0.14	0.30
30		-0.20	0.24	0.08	0.67
60			0.06	0.27	0.06
90				0.43	0.20
120					0.43

CONCLUSIONS

The more appropriate period to use the canopy reflectance sensor in sugarcane to relate the demand for nitrogen by the plant is when there is a stand of 16-20 tillers per meter and the plant height is approximately 0.20m.

ACKNOWLEDGMENT

FAPESP (Process nº2013/01417-2) which is financing the first author PhD scholarship.

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