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Title

Nitrogen Fertilization in maize using the Portable Chlorophyll Meter

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Introduction

The cultivation of maize is one of the most important crops for the Brazilian Agribusiness. In the growing season of 2007/2008 the production was above 50 million tons, representing 6.4% of world production (Bozzo, 2007). In recent years, many techniques for identification of nitrogen deficiency have been proposed, such as portable chlorophyll meter (PCM), analysis of leaf tissue and evaluating the content of nitrate in the soil. Among these techniques, the use of portable chlorophyll meter has been widely used, especially in tests of calibration and evaluation of deficiency. According to Rambo (2004), papers using the chlorophyll meter to indicate amount of N to be applied do not exist in the literature.

Some authors suggest that among the advantages of the PCM are the preservation of plant tissues, and accuracy in evaluation and indirect diagnosis (PELTONEN et al, 1995). Recently, Reis et al (2006) developed a study with the main objective of generating a curve of nitrogen fertilization using the chlorophyll readings. In the U.S., the most used technique is the sufficiency index, by the comparison with the reference plots (PELTONEN et al, 1995) and monitoring the N fertilization. This method is interesting, however, it does not respect the basic principle of the curve of response and can indicate nitrogen values higher than those that should be used. Most studies have used the PCM Minolta SPAD 502, which is produced in Japan and other countries. This study aimed to evaluate the PCM Falker Chlorophyll meter, in respect to its calibration with doses, leaf content, yield, and develop an appropriate curve of nitrogen fertilization for maize.

This work was carried out at the Experimental Station of the Sao Paulo State University-UNESP, located in Selvíria, State of Mato Grosso do Sul, Brazil. The experimental design was the randomized completely blocks with four replications and 6 treatments with nitrogen fertilization by coverage (0, 60, 100, 120, 140 and 160 kg N ha⁻¹) using urea. The row spacing was 0.9 m, with the plant population of 55000 plants ha⁻¹. The sowing was realized on the first of December, 2007 with 90 kg P₂O₅ ha⁻¹, 50 kg K₂O ha⁻¹ and 20 kg ha⁻¹ of nitrogen, according to the recommendations of Rajj et al (1997). The nitrogen in coverage was applied 18 days after plant emergence. The emergence of maize occurred on December 9, 2007. Each plot was composed by 6 lines with a length of 6 m, with a total amount of 24 plots.

Five evaluations of the Chlorophyll readings were realized (ICF index) from 25 to 53 days after emergence of maize plants. The evaluations were conducted in the C leaf (first with the visible collar) and C-1 leaf (prior to the first with the visible collar), and assessed four plants per plot and five readings per leaf in the middle third.

The collection of the leaves was realized according to the recommendations of Malavolta et al (1997), and performed the chemical analysis of plant tissue to determine the leaf nitrogen content, by the methodology proposed by Bataglia et al (1983). The recommendation of nitrogen fertilization based on readings ICF was done using an adapted methodology from REIS et al., (2006).

The first part of this study was to evaluate the calibration of equipment to increased levels of nitrogen. Thus, there were evaluations of ICF readings during the development of the maize plant, from 25 to 53 days after crop emergence. It was found in all samples, significant effects of doses on the readings, with the linear effect in all evaluations and quadratic effects in three, and the determination index with better adjustment observed for second degree regression at 46 and 53 days after germination.

The evaluation from the point of maximum showed that the plant increases the ICF readings until the dose of 140 kg N ha⁻¹ at 53 days after emergence. The early evaluation is important

because the potential yield is defined at the emission of the 4th leaf, and can be extended to the 6th leaf (Fancelli, 1997).

This also verified the relationship between N rates and nitrogen content and it was affected by increasing doses of this nutrient, until the dose of 120 kg N ha⁻¹. However, the yield was affected until the dose of 160 kg N ha⁻¹.

The recommendations of nitrogen fertilization, according to the values of ICF readings, are contained in Figure 1. It was verified that, for example, if the reading was 60, the nitrogen fertilization should be 140 kg ha⁻¹. The value of reading at the time of nitrogen covering fertilization will be used to verify the amount of N to be applied. This system is more efficient than the sufficiency index, which does not use a curve of response and possibly overestimate the needs of N, and may even underestimate them, as described by Sawyer (2007). Who obtained values of fertilization at the maximum of 112 kg N ha⁻¹ in the United States.

The curve of nitrogen fertilization using the PCM Falker Clorofilog was possible by the excellent correlation between doses and readings, doses and N content (Figure 3) and doses and grain yield (Figure 2). The recommendation is valid under the conditions which the work was developed. With the use of other hybrids, or different production systems is necessary to develop equivalence factors (EF) proposed by Santos (2006).

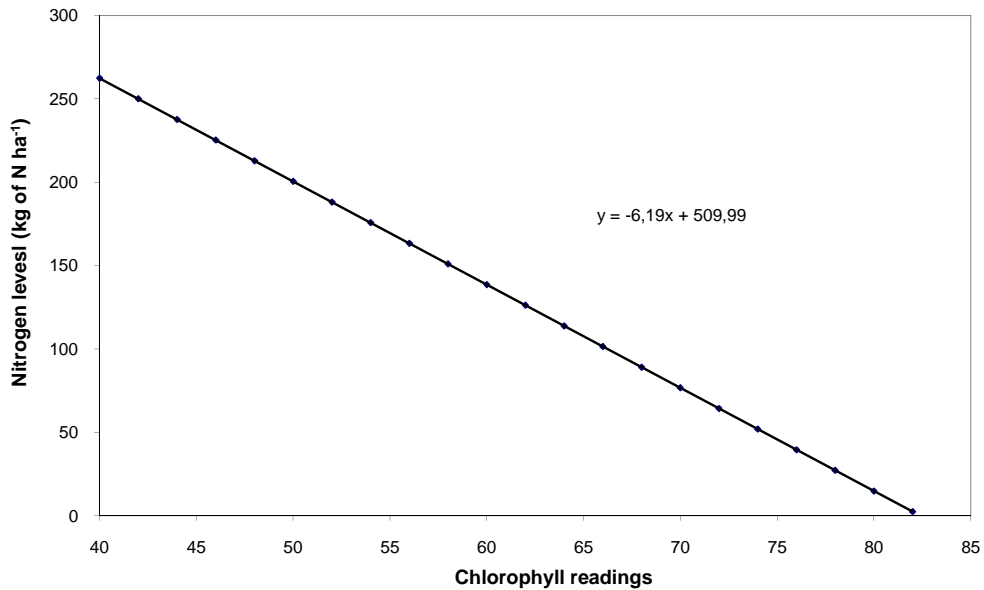


Figure 1. Nitrogen levels to be used for fertilization using the ICF readings

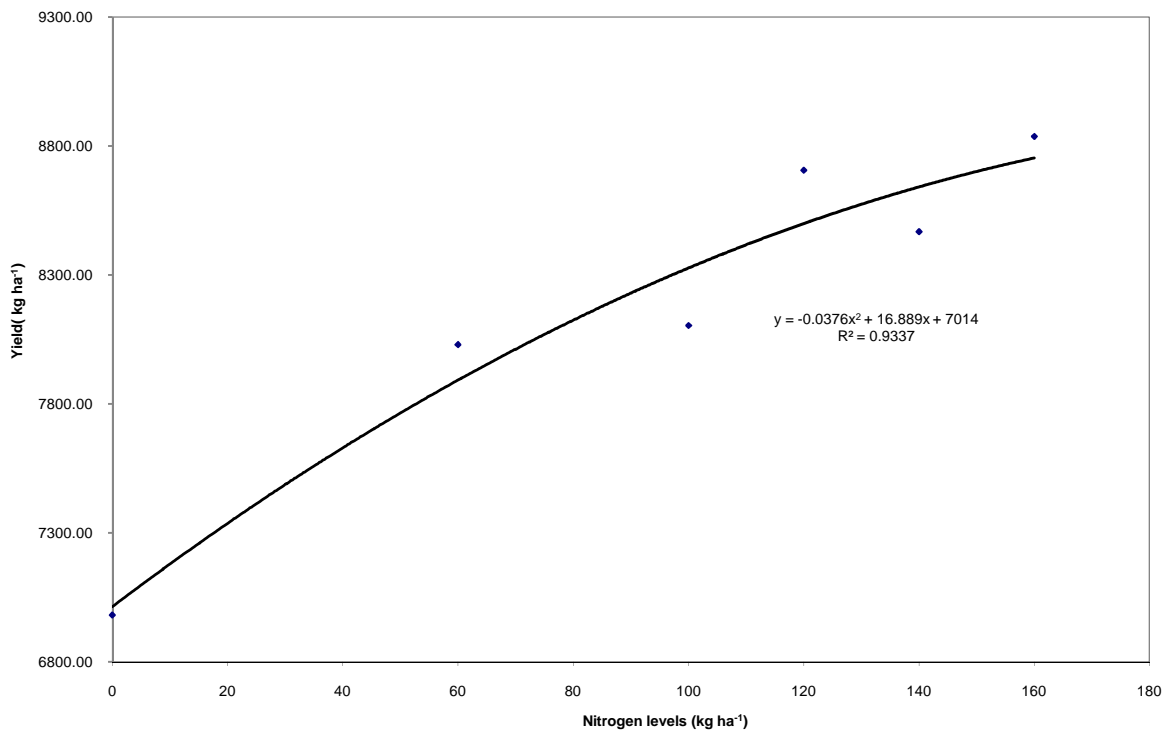


Figure 2. Maize Yield under nitrogen levels (kg ha⁻¹)

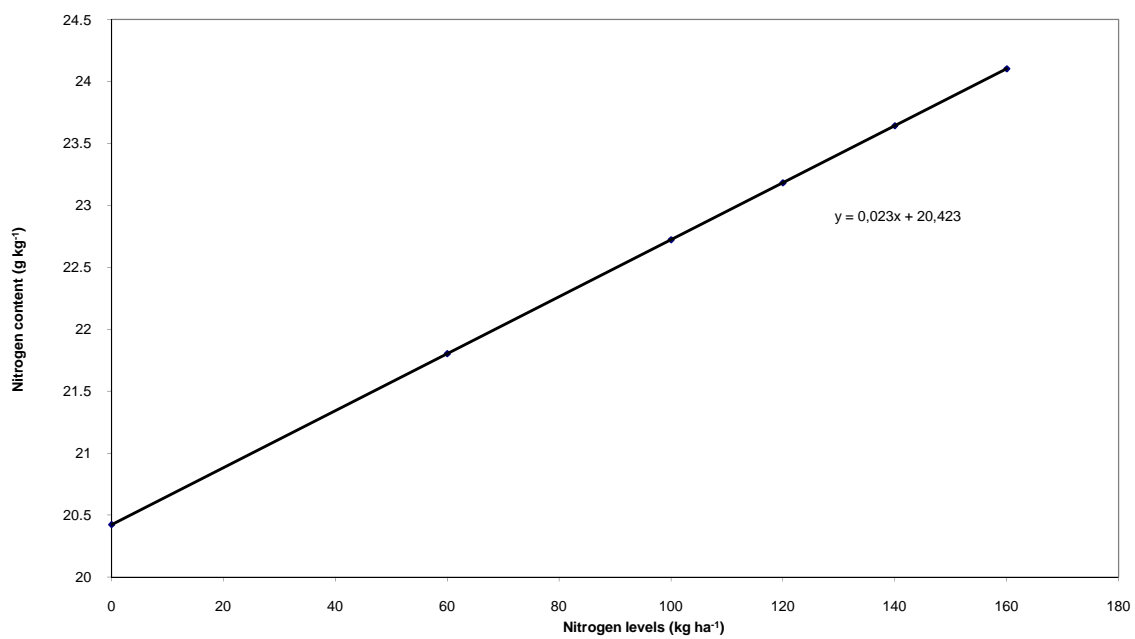


Figure 3. Nitrogen content as a function of nitrogen levels

It was concluded that there was a good correlation between levels of nitrogen applied in coverage, with ICF readings ICF, nitrogen content and grain yield. It is possible to establish a curve for the nitrogen fertilization by the ICF readings at the time of covering.

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