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USE OF CHLOROPHYLL-SPAD METER ON POTATO AND SORGHUM

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Introduction

The SPAD-502 chlorophyll meter measures the transmittance of leaves at 430 nm, which is a peak of maximum absorbance by chl, providing an indication of its chl content. Chlorophyll content of leaves or SPAD readings can be used as a nitrogen nutrition index of plants since most leaf N is contained in chl molecules. In order to avoid the interference of factors besides N fertility on the interpretation of results, Peterson et al. (1993) suggest the use of a N sufficiency index calculated as follows:

Sufficiency index = (Average bulk readings)/(Average reference strip readings) x 100 %.

The reference strips must be well supplied with N. A sufficiency index lower than 95 % indicates a shortage of N. In this work we study the relation between SPAD readings and laboratory measurements of chl pigments on potato and sorghum as a function of N applied. We inquire into some aspects of the use of the N sufficiency index related to the reference strips.

Material and methods

In the experimental farm of the Polytechnical Institute of Bragança two N-fertilizer experiments with potato and sorghum were imposed on a loamy textured soil. During the growing season the chlorophyll content of leaves was measured in the field with the SPAD meter and determined in the laboratory. The laboratory method uses 1 cm^2 of green tissue and methanol as solvent and the extracts are read spectrofotometrically in 3 wavelengths: 470, 651 and 664 nm. Lab chl analysis and SPAD readings were made on 15 randomly chosen plants per plot at mid-length for sorghum and at the distal leaflet for potato on the uppermost fully expanded leaves. The leaf's midrib was avoided in both crops.

Results and discussion

The quadratic relations found between laboratory and SPAD readings of chlorophyll indicated that the SPAD meter underestimated the chl content of leaves for most fertilized plants, with higher chl content (fig 1), relatively to the lab method. Changes in the relation between the two chl pigments as a result of N fertilization (fig 2) with probable changes in peaks of absorbance and the fact that the laboratory method reads in two wavelengths (651 nm for chl a and 654 for chl b), whereas the SPAD meter only reads one wavelength (430 nm), can justify the result.

The chlorophyll content of leaves (lab method) as well as the SPAD readings increased with moderate N rates and decreased with high N rates (fig 3 and 4). The initial increase is justified by the synthesis of more chl associated with more available N. The decrease is attributed to the lesser thickness of the leaves, with less optical density, caused by higher N rates and higher mutual shading of plants. With SPAD readings that effect is more evident and the reasons for this are the same as those presented to justify the results of fig 1. The effect was also more evident for the potato crop because of the higher extinction coefficient of its canopy.

Conclusion

The SPAD meter seems to have limitations in detecting minor changes in chlorophyll pigments that could occur, motivated by crop management and ecological factors, in so far as the portable tool only reads one wavelength.

The results suggest that there must be caution in the use of N sufficiency index on crops like the potato, where the effect of high N rates on chlorophyll-SPAD readings could be confounded with the effect of insufficient N. In this crop the reference strips would never be supplied with excessive N.

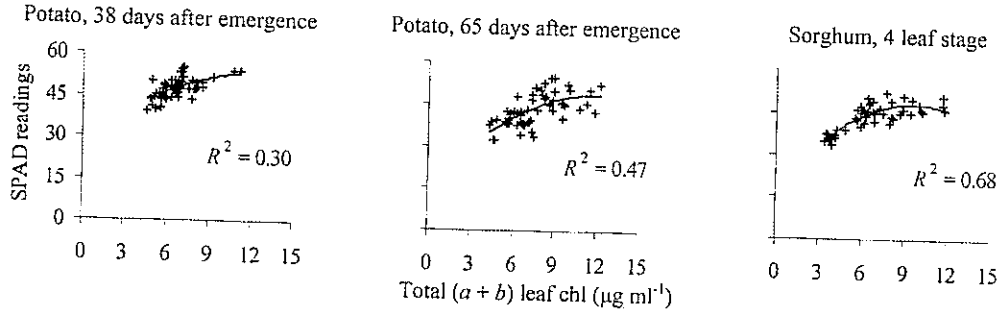

Figure 1 – Relation between leaf chlorophyll (lab. method) and SPAD readings.

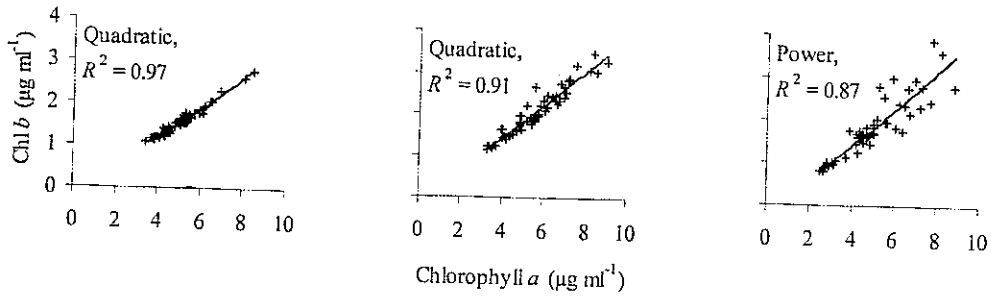

Figure 2 – Relation between chlorophyll a and chlorophyll b for all N-fertilizer treatments.

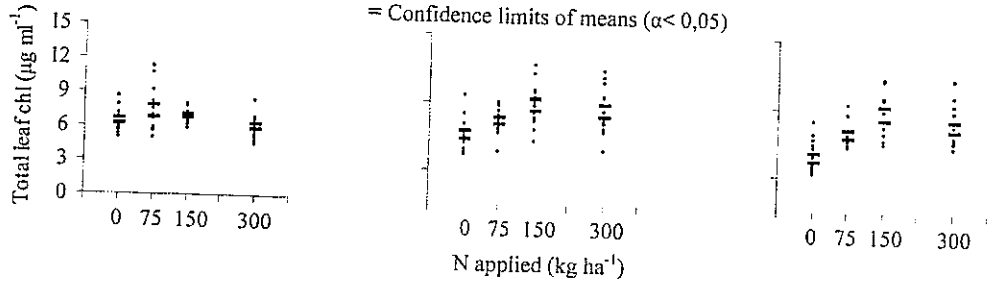

Figure 3 – Relation between N applied and total (a+b) leaf chlorophyll.

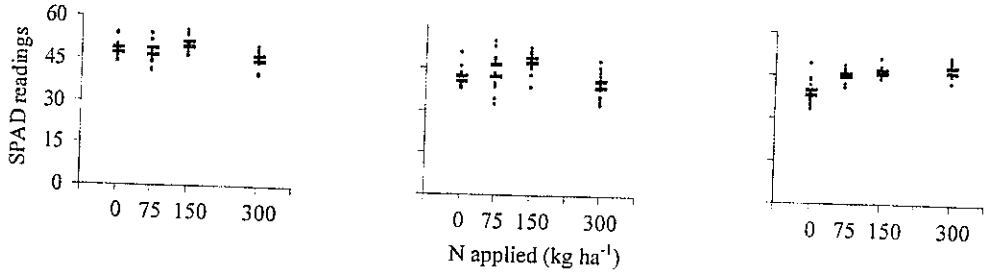

Figure 4 – Relation between N applied and SPAD readings.

References

Peterson, T.; T. Blackmer; D. Francis and J. Schepers. 1993. Using a chlorophyll meter to improve N management. Coop. Ext., Inst. Agr. Nat. Res., Univ. Nebraska-Lincoln. No. G93-1171-a.