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Beyond Classical Approaches

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THE POTENTIAL OF CHLOROPHYLL CONTENT SPAD METER TO QUANTIFY NUTRIENT STRESS IN FOLIAR TISSUE OF *FILICIUM DECIPIENS* AND *CINNAMOMUM INERS*

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ABSTRACT

Urban environments present an array of environmental factors hostile to the growth of urban trees such as soil compaction, water stress and aerial pollution. These stresses limit the amount of carbohydrates available for growth and reduce nutrient uptake resulting in leaf chlorosis and necrosis. The chlorophyll content (or SPAD meter) is a simple, portable diagnostic tool that measures the greenness or relative chlorophyll content of leaves. Compared with the traditional destructive methods of chlorophyll extraction, the use of this equipment saves time, space, and resources. The objective of this study was to establish a correlation between the leaf photosynthetic pigment content (chlorophylls, carotenoids) extracted in aqueous acetone, total leaf nitrogen (N) content, and values with the SPAD-502 readings in *Filicium decipiens* and *Cinnamomum iners* leaves displaying visual symptoms of N deficiency. Irrespective of species, high correlations were recorded between SPAD readings, total leaf chlorophyll and carotenoid content and foliar N content. In the case of *F. decipiens* and *C. iners*, SPAD readings lower than 25 indicated impairment of leaf photosynthetic process that in turn were correlated with a foliar N content less than 1.5%, a value associated with a critical N deficiency. Results of this study indicate that the chlorophyll content SPAD-502 potentially offers a useful nondestructive, handheld system to aid in the evaluation of tree health in the urban environment.

Keywords: Urban environment, Chlorophyll, Carotenoids, nitrogen fertilization, stress detection, tree evaluation.

INTRODUCTION

Urban environments present an array of environmental factors hostile to the growth of urban trees such as soil compaction, water stress and aerial pollution. These stresses limit the amount of carbohydrates available for growth and reduce nutrient uptake resulting in leaf chlorosis and necrosis (Jimenez *et al.* 1997; Mohammed *et al.* 1997; Maki and Colombo 2001). These symptoms become manifest as leaf yellowing that is visible indicators arborists interpret to assess tree vitality (Percival 2004). Visual observations can be very subjective because they are based on human knowledge and interpretation that can significantly differ between individuals and health evaluations can be markedly different between assessors (Percival 2004). The availability of field diagnostic tools are required to objectively evaluate stress disorders in trees as a basis for management decisions on cultural practice and for proactive monitoring in urban landscapes (Loh *et al.* 2002). Detection of stress can therefore be made before the visible symptoms of plant deterioration become manifested and therefore make possible effective remedial intervention (Percival and Fraser 2001).

The content and efficiency of leaf photosynthetic pigments and/or their reciprocal ratio are affected by both biotic and abiotic stress factors (Bacci *et al.* 1998). For example, the assessment of leaf photosynthetic pigments is an important indicator of senescence because breakdown of leaf chlorophyll is associated with environmental stress (Brown *et al.* 1991). The variation in total chlorophyll/carotenoids ratio has been used as a useful indicator of stress in plants because a rapid increase in total leaf carotenoid content is a recognized plant stress response (Hendry and Price 1993) and exact knowledge of foliar chlorophyll concentrations, i.e., "greenness," consequently may provide a robust and accurate estimation of tree vitality (Percivel