Study the affiliation of SPAD and leaf nitrogen with total chlorophyll in Sugarcane
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Abstract

In order to ascertain the correlation between SPAD reading and actual leaf chlorophyll content as well as illuminating it saffiliation with leaf nitrogen content of sugarcane an experiment accomplished using completely randomized design with three replications in the field of the Sugarcane Plantation and Industry Company of Amirkabir located in Khuzestan province, Ahvaz- Iran in 2012 cropping season. To cope with this research, initially sugarcane’s leaves marked in accordance with their position on the stem with due care to their size and weight. The total chlorophyll content and chlorophyll (a,b) along with nitrogen content of leaf blade was determined. Results showed signification and direct relationship between SPAD reading and leaf nitrogen content ($r^2 = 0.81$). With the increment of SPAD readings, total chlorophyll content and leaf nitrogen content increased. Also positive and high correlation established between variables.

Keywords: Chlorophyll meter, total chlorophyll content, leaf nitrogen and Sugarcane

Introduction

For investigating the content of leaf chlorophyll through nondestructive method a fool proof Minolta Tapan, SPAD 502 makes it achievable. The computed values by this device represents the whole content of chlorophyll (a, b) in plant, (Feibo et al., 1998; Ichie et al., 2002; Ramesh et al., 2002). Capability of Chlorophyll meter instrument as an indicator for qualitative testing of ten species of forage plant exploited by Wang et al. (2005) who observed high correlation between SPAD values, chlorophyll (a,b) and total chlorophyll content. Chlorophyll rate per unit of leaf area is an appropriate criterion of leaf photosynthesis and productivity. Schlemmer et al. (2005) by setting off some measurements in quest of maize physiological parameters in response to environmental factors proved that in both case of accessibility to water sufficiency and water deficiency, there was a positive and significant linear relationship between leaf chlorophyll content and nitrogen source.
per area unit. Corresponding results were reported by Martines and Guiament (2004) on maize. The linear correlation between SPAD value and stem nitrogen content was documented in menthpipeperita (Wescott and Vrise, 2003). In a similar way, positive regression relationship between SPAD meter and total chlorophyll of leaves was also shown (Kapotis et al., 2003). Since the chlorophyll meter calculates the leaf chlorophyll content of plants, it would be possible to estimate leaf nitrogen content through counting SPAD value and leaf chlorophyll content in both fertilized plants and control treatments. Notably, this subject enables researchers to set up a project to fertilize the plants according to their absolute needs which not only modifies the risk of crop reduction due to nutrient scarcity but also alleviates the cost of extra fertilizing (Ahmad John et al., 1999). Today chlorophyll meter recruitment for representing the impacts of environmental contaminants on leaf chlorophyll content as well as regarding the plants which contributes to biosynthetic activities with a mutation is undeniable (Bouchanan-wollaston and Aienwers, 1997). Numerous studies supported a significant linear relationship between SPAD value, nitrogen concentration and leaf chlorophyll in rice (Bullock et al., 1995) and cotton (Feibo et al., 1998) which is a pivotal solution for nitrogen management in the field condition. Also similar relationship recognized between SPAD value and some of the leaf physiological parameters like as photosynthesis, stomata conductivity and transpiration. In general, it is more than likely that healthy plants leaves with higher chlorophyll content have vigorous growth and better development. Hence calculating the rate of leaf chlorophyll is constructive for determining the ratio of plant nutritious during stress conditions (Krugh et al., 1994). Moreover, they found a linear relationship between SPAD value and total chlorophyll content by ongoing studies on seedling's leaf of Maize through which they conferred a standard curve to assess the real chlorophyll per unit area. The reduction of chlorophyll content owing to environmental stresses and differentiation in ratio of total chlorophyll content to carotenoid rate might be a key for rating stress in plants (Hendry and Price, 1993). SPAD reading is requisite in specific segments of a leaf during various stages of plant growth because of changing conditions that occur in the terms of plant development (Anderson et al., 1993). According to assertion of Marquard and Tipton (1987) chlorophyll meter is an efficient tool for rating the photosynthetic potential of plant leaves by which the interpretation of plant photochemical stages is plausible. In addition by extensive research on coffee Arabica they proved that photosynthetic pigments threatened to deterioration as chlorophyll meter displays the values fewer than 40.

Consequently, in regard to the subject matter, this experiment aimed to evaluate the correlation of SPAD value with total leaf chlorophyll content, chlorophyll (a, b) and total nitrogen percentage as well as the relationship of total nitrogen with total chlorophyll rate of sugarcane.

**Materials and Methods**

In this experimental study, a completely randomized design arranged in three replications were selected randomly from one of sugarcane plantation and industry farms of Amir Kabir located in south of Khuzestan province and there after the chlorophyll content of hand-picked leaves were measured by means of a chlorophyll meter (Minolta Tapan, SPAD-502). Subsequently, sampling leaves detached from the stems and carried to the laboratory. The leaves were rinsed and after wiping them clean, about 0.25g of the plant tissue clipped and the remaining fragments were kept in an oven at the temperature of 75°C around 24h to determine the total nitrogen rate. Also for estimating chlorophyll content, 0.25g sample of separated plant
tissue was mixed with 5 ml of distilled water and grinded in a crucible. The total chlorophyll and nitrogen were determined by standard methods using a spectrophotometer and the values were compared using EXCEL and Minitab software to determine the regression analysis.

**Results and Discussion**

Based on the linear relationship there was a positive and significant correlation between SPAD value and leaf nitrogen percentage ($r^2 = 0.81$) (Fig.-1).

The results showed that with SPAD value the enhancement of the rate of leaf chlorophyll content increased, and showed positive correlation ($r^2 = 0.66$) (Fig.-2). With the increment of chlorophyll content, the leaf nitrogen percentage indicated a cumulative trend. Also the total chlorophyll content was highly correlated with leaf nitrogen percentage.

The results of this research indicated that SPAD value positively correlated with the rate of chlorophyll content and the rate of leaf nitrogen for which our results are supported by those of other researchers. The positive regression relationship between SPAD value and total leaf chlorophyll of Amaranthus was reported (Kapotic et al., 2003). In similar way Feibo et al. (1998) obtained a high correlation ($r^2 = 0.78$) between chlorophyll content and SPAD value in cotton.

Other studies have discerned a linear regression between SPAD values and total chlorophyll content in the seedling leaves of maize (Krugh et al. 1994). The affiliation of photosynthetic pigments, nitrogen content, the rate of chlorophyll (a) and SPAD reading were investigated in coffee leaves (Netro et al., 2005). They alleged that polynomial equation (2) was the best mathematical model to express the relationship between the reading of SPAD meter and the rate of photosynthetic pigments, while Schaper and Chucko (1991) seeking the same experiment, expressed the relationship in the form of linear instead, for which our results are supported by previous researchers. Peng et al. (1993) and Ladha et al. (1998) by recruiting chlorophyll meter to determine fertilizing requirement in rice reported that the linear relationship between nitrogen rate and SPAD reading depended on the growth stage and different cultivars of rice. The correlation of nitrogen with SPAD reading varied from 0.83 to 0.93 depending on different varieties. Regarding the importance of nitrogen usage in the molecular structure of chlorophyll and enzyme biphosphatase ribolazed carboxylates, the leaves with more chlorophyll content were deserved higher nitrogen concentration (Maquard and Tipton, 1987). By an elaborative work on maize (Peterson et al., 1993) uncovered a close relationship between the leaf
chlorophyll content and the leaf nitrogen rate, by which they alluded a pivotal task for nitrogen in the molecular structure of chlorophyll.

Conclusion

On the basis of results, with the enhancement of the coherent value with SPAD meter that is an indicator of the leaf chlorophyll increase, total chlorophyll content increased so that positive and highly relationship established between these variables. Therefore, instead of destructive method which was so tardy and expensive it would be practicable to use SPAD meter for estimating the status of plant chlorophyll and nitrogen. As a consequence redoing this experiment culminated in standard curve by which can detect the rate of plant chlorophyll and nitrogen as well as projecting lot of complicated and economical experiments.

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References


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