EVALUATION OF SPAD CHLOROPHYLL IN WILD AND CULTIVATED POTATO GENOTYPES UNDER DIFFERENT ENVIRONMENTS

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1. INTRODUCTION

Chlorophyll is the most important material to absorb light energy, which directly affects the light energy utilization of crop photosynthesis. The chlorophyll content of crops has a good correlation with their photosynthetic capacity, developmental stages and nitrogen status. Thus, it has become an effective mean to evaluate crop growth. The reflectance spectrum of crop leaves is mainly affected by crop pigments in the visible light range (DORDAS, 2017; ZHAO *et al.*, 2016). However, it is mainly affected by the internal structure of leaves in the near-infrared region. Therefore, it can be used as a reflection spectrum of the canopy layer and leaves to estimate its biochemical parameters, especially the chlorophyll content (FENG *et al.*, 2018; MESKINI-VISHKAEE *et al.*, 2015).

In potato breeding, the selection efficiency can be increased if specific physiological and/or morphological traits related to yield under specific environments can be identified and used as selection criteria to complement traditional plant breeding (ACEVEDO, 1991). Total chlorophyll content per leaf area can be estimated in a fast, single, and nondestructive way using a portable chlorophyll meter such as the SPAD-502 (Soil-Plant Analysis Development Section, Minolta Camera Co., Ltd., Osaka, Japan). The chlorophyll meter is a simple, portable diagnostic tool that measures leaf greenness, i.e., the relative chlorophyll concentration in leaves. Compared with traditional destructive methods, this method provides substantial savings in time, space, and resources (NETTO *et al.*, 2005). The SPAD meter measures transmittance by leaves at two wavelengths (650 nm and 940 nm) that are differentially absorbed by chlorophyll, and estimates leaf chlorophyll.

2. METHODOLOGY

We evaluated 20 wild potato genotypes including *Solanum commersonii* (BGB009, BGB045, BGB451) and *S. chacoense* (BGB083, BGB086, BGB088, BGB089, BGB091, BGB093, BGB096, BGB098, BGB101, BGB102, BGB103, BGB107, BGB109, BGB113, BGB444 and BGB467), and one potato genotype of *S. tuberosum* commercial cultivar BEL (PEREIRA *et al.*, 2015) grown in factorial experimental design with two temperature treatments. Control with temperature range of 14-27ºC and heat treatment with temperature range of 24-34ºC, both with 12 h photoperiod.

The chlorophyll contents were measured after 12 days of stress (DAS), 20 DAS, 27, DAS, 33 DAS, 43 DAS, 47 DAS and 54 DAS. The instrument used was SPAD-502 model manufactured by Minolta Camera Co., Ltd, Osaka, Japan. It determines the amount of chlorophyll by measuring the transmittance of a leaf at two wavelengths, namely approximately 430 nm and 750 nm. The instrument can easily be held in the hand, and up to 30 individual readings can be stored, selectively deleted, replaced and averaged. The measuring head consists of two hinged parts and is clamped onto a leaf. The two sources in the emitting part of the head emit a beam of light; the transmittance across the leaf is measured by the receptors in the opposite part of the head. A reading takes only a few seconds to make, and the speed of sampling a field is determined by the speed with which one can move and the time needed to select a leaf. The recorded data was analyzed for Factorial ANOVA and Scott-Knott test by “easyanova” R package (ARNHOLD; ARNHOLD, 2019).

3. RESULTS AND DISCUSSION

In terms of genotype x environment interaction (Table 1.), chlorophyll content was significantly different until 33 days after stress. Nonsignificant difference was observed among potato germplasm after 43 and 47 days of stress application.

Table 1. ANOVA for chlorophyll content of 21 potato genotypes.

Source	df	CC_12DAS	CC_20DAS	CC_27DAS	CC_33DAS	CC_43DAS	CC_47DAS
		Mean Squares					
Environment (E)	1	53.2*	469.1**	154.7**	137.7**	134.3*	103^{ns}
Genotype (G)	20	2671.7**	1641.9**	1492.3***	1749.3**	1224.3**	1486.9**
G X E	20	368.5*	513.1*	434.5*	456.7*	886.8^{ns}	886.7^{ns}
CV %		7.87	9.10	8.97	8.52	13.48	14.30

^{ns} Nonsignificant, P > 0.05; *significant at P ≤ 0.05; ** significant at P ≤ 0.01 for Chlorophyll content measured at 12, 20, 27, 33, 43 and 47 days of stress application.

The mean values for all potato genotypes were higher in stress condition as compared to control environment. BGB109, *S. chacoense* has the highest mean SPAD chlorophyll content value in most of observations. While BGB009, *S. commersonii* showed lowest mean values under 12, 20 and 33 days under stress conditions. As it is well known that SPAD meter measure the pigment of the leaves, higher the values under heat stress, higher will be the physiological efficiency of the plant. From this study, it is observed that under stress conditions BGB109 showed the significant higher values for the SPAD values. So, it can be used as potential candidate for the assessment of the other physiological traits considered important for abiotic tolerance.

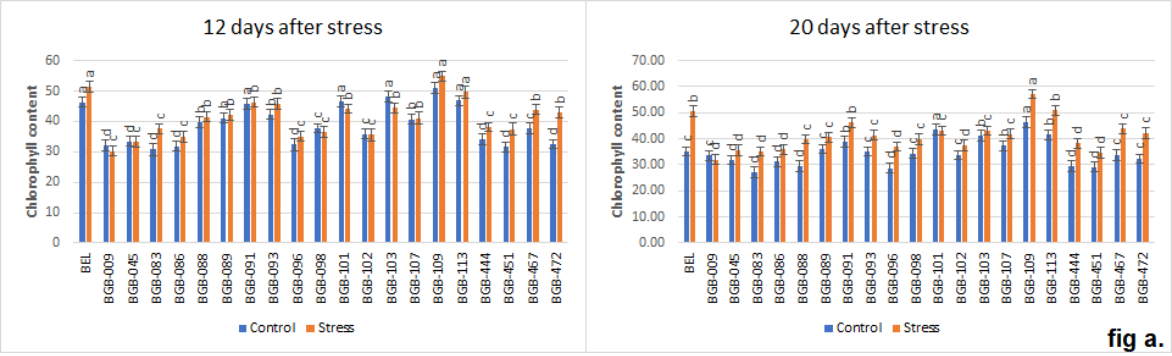
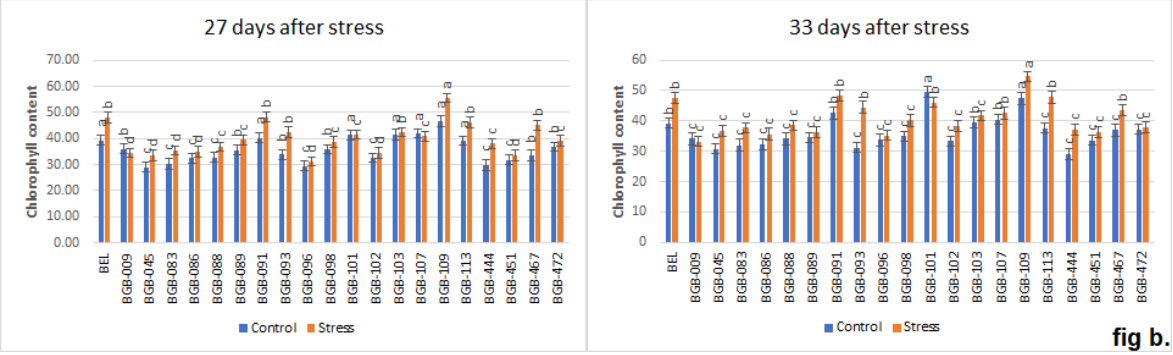


fig a.



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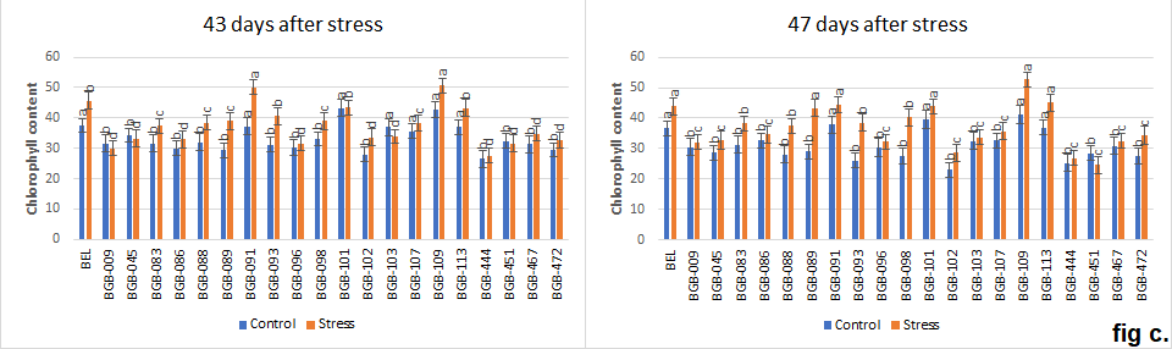

fig c.

4. CONCLUSIONS

The potato wild accession BGB109 showed higher SPAD chlorophyll values under the stress conditions. This result is likely due to the wider adaptability of the germplasm under natural conditions. Thus, it points that wild germplasm could be a source of important physiological traits for breeding with focus on stressful environment conditions.

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