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DROUGHT TOLERANCE OF COMMON BEAN GENOTYPES CHARACTERIZED BY PHYSIOLOGICAL AND BIOCHEMICAL MARKERS

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INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) is considered the main legume for human consumption, being an important source of proteins, carbohydrates and minerals. However, most of its farming occurs under drought conditions, with water deficit being one of the main limiting factors for production, which can reduce it by up to 80% (ROSALES et al., 2012). The effects of drought on the common bean depend on the frequency, duration and intensity of the stress and the phenological stage of the crop, which can affect the photosynthetic efficiency, stomatal conductance, transpiration rate and solute accumulation. Quantifying these components related to drought tolerance is extremely important to define strategies for their use in breeding programs. Therefore, the present study aimed to evaluate two common bean genotypes for tolerance to drought through biochemical and physiological characteristics.

MATERIAL AND METHODS

The experiment was conducted in greenhouse, at Agronomic Institute of Paraná State, the experimental design was randomized blocks with six replications and two tolerant cultivars were evaluated, IAPAR 81 and BAT 477. The plants were grown in pots with substrate under 80% of the pot capacity until the phenological stage R5, when the drought began in plots subjected to stress, in which was adopted the water treatment of 30% of the pot capacity for 19 days. Liquid photosynthesis, stomatal conductance, transpiration and carboxylation efficiency of the plant were measured in the morning on sunny days, on the last day of stress, using the portable system Photosynthesis LI-6400XT (LI-COR Biosciences, Lincoln, NE, EUA). For the biochemical analyzes (GPX, APX, protein and proline) it was collected, also in the last day of stress, a leaflet of each plant, arranged in bulk and diluted in proportion 1:5 in four different buffer solutions according to the analyzes. Data were submitted to analysis of variance and Tukey test at 5% of probability by the computer program R (<http://www.r-project.org>) using the ExpDes and MVar.pt packages.

RESULTS AND DISCUSSION

The results indicated physiological and biochemical changes when the cultivars were submitted to water deficit in the reproductive period. The values of liquid photosynthesis, stomatal conductance and transpiration decreased in both genotypes when submitted to water deficit, but it was not observed statistical difference between the genotypes under stress conditions (Table 1). The first reaction of plants to water deficit is the stomata closing for less water loss by transpiration, reducing the availability of CO₂ inside the leaf, which causes a decrease in the rate of photosynthesis (ANDROCIOLOI et al., 2016). The carboxylation efficiency decreased only in BAT 477 under drought conditions and IAPAR 81 presented statistically higher values for this variable, besides having the highest rate of liquid photosynthesis, demonstrating physiological efficiency when submitted to drought. In the biochemical analyzes, an accumulation of GPX and

proline was observed only in BAT 477 under water stress and it was verified statistical difference between the cultivars only for GPX, with BAT 477 presenting the highest value for this characteristic (Table 1). One of the most common responses to stresses in plants is the overproduction of different types of organic solutes (ASHRAF; FOOLAD, 2007). The accumulation of proline in plants under water deficit has been correlated with stress tolerance, and their concentration has generally been shown to be higher in tolerant plants than in plants sensitive to stress. It was observed reduction of APX and protein for both genotypes. Still both cultivars being drought tolerant, IAPAR 81 presented physiological adaptations to drought while BAT 477 showed higher values on biochemical characteristics for the same conditions.

Table 1 - Averages comparison by Tukey method ($P < 0.05$) for physiological and biochemical traits of common bean genotypes evaluated in the presence and absence of water deficit.

Genotypes	A		g_s		T		CE	
	Control	WD ^{2/}	Control	WD	Control	WD	Control	WD
BAT 477	16.31Aab	3.35Bab	0.422Aa	0.034Ba	3.70Ab	0.59Ba	0.053Aab	0.014Bb
IAPAR 81	14.50Ab	6.34Ba	0.286Ab	0.049Ba	4.74Aa	1.03Ba	0.050Aab	0.035Aa
Genotypes	GPX		APX		Protein		Proline	
	Control	WD	Control	WD	Control	WD	Control	WD
BAT 477	0.345Ba	0.608Aa	1.289Aa	0.784Bab	18.853Aa	4.379Ba	0.643Bc	0.957Ab
IAPAR 81	0.233Ab	0.248Ab	1.004Aab	0.623Bb	19.538Aa	3.626Ba	0.887Ab	0.843Ab

^{1/}A: liquid photosynthesis ($\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$), g_s : stomatal conductance ($\text{mol m}^{-2} \text{ s}^{-1}$), T: transpiration ($\text{mol H}_2\text{O m}^{-2} \text{ s}^{-1}$), CE: carboxylation efficiency ($\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1} \text{ Pa}^{-1}$), GPX: glutathione peroxidase (activity per minute), APX: ascorbate peroxidase (activity per minute); ^{2/}WD: water deficit, Means followed by the same lowercase letter in the column and upper case in the row do not differ from each other by the Tukey test at 5% of probability.

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