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ORIGINAL ARTICLE

Morpho-physiological criteria for assessment of two month old cocoa (*Theobroma cacao* L.) genotypes for drought tolerance

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Abstract Cocoa (*Theobroma cacao* L.) is sensitive to water deficit stress which is the main factor limiting its productivity. Morpho-physiological responses of cocoa hybrids to differential water deficits at young age showed significant differences under controlled condition. Physiological parameters, viz., water status, gas exchange, photosynthesis and photochemical activities, despite having good correlation among them, may not contribute as selection criteria separately. However, simultaneously they distinguished the hybrids under induced water stress. Three different behavioral groups were categorized, the first group showed small reduction in photosynthesis, followed by maintenance of water use efficiency with low conductance and low transpiration rate in the hybrids VTLCP-22, VTLCP-24 and VTLCH-4. The second group included hybrids VTLCP-27, VTLCP-25 and VTLCP-26, which had adequate functioning of PSII, net photosynthetic activity, reduced transpiration rate, high stomatal resistance and vegetative vigor. Third group comprising of hybrids VTLCH-3, VTLCP-11, VTLCP-28 and VTLCP-29 has high transpiration rate, reduction of PSII photochemical activity and low CO_2. Cocoa exhibited significant genotypic variation with physiological parameters at young age and breeding for these traits may improve the performance and sustainability under specific growing conditions.

Keywords *Theobroma cacao* L. · Drought tolerance Morphological · Physiological parameters

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Introduction

Abiotic stresses such as extreme temperatures, salinity and low soil water potential are factors limiting plant growth and agriculture production. Cocoa (*Theobroma cacao* L.) is a crop of humid tropics grown for its beans which is the source for chocolates. In recent decades, areas under cocoa cultivation are marked by strong climate variability, characterized by higher temperatures, decrease in rainfall and shorter rainy seasons (Brou et al. 2005). In India, cocoa is grown as a mixed crop in palm based cropping systems in traditional zones of Kerala and Karnataka under coconut and areca nut and non- traditional zones in Tamil Nadu and Andhra Pradesh states under coconut and to some extend in oil palm gardens. In the present growing situation cocoa is undergoing a period of 4–6 months of dry period, which is supplemented with irrigation. If the total rainfall reduces from the optimal level of 1200–1600 mm, significant losses have been observed in the development and productivity of cocoa, and in extreme cases lead to death of the tree. Influence of soil water deficit and its effect on its morphology, physiology and productivity have been studied by many workers (Braudeau 1969; Boyer 1973; Alvim 1988; Joly and Hohn 1989; Moser et al. 2010). Despite its high sensitivity to water stress, field observations indicated that cocoa genotypes exhibited a satisfactory level of tolerance to drought with sufficient productivity (Balasimha et al. 1999). However, in perennial plants, field studies