Scientia Horticulturae 143 (2012) 7–14

Contents lists available at SciVerse ScienceDirect

Scientia Horticulturae

journal homepage: www.elsevier.com/locate/scihorti

Use of rapid screening methods for detecting drought tolerant cultivars of fig (*Ficus carica* L.)

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ARTICLE INFO

Article history:
Received 25 December 2011
Received in revised form 12 May 2012
Accepted 15 May 2012

Keywords:
Drought
Ficus carica
Irrigation
Recovery

ABSTRACT

A preliminary study was conducted to determine the effects of water stress on four fig cultivars (*Ficus carica* L., 'Deyme Ahvaz' (Deym), 'Sabz Estahban' (Sabz), 'Siah' and 'Shahanjir' (Shah)) plants, using reliable and easy to use methodology. Potted plants, growing under greenhouse conditions were subjected to drought by withholding irrigation for 14 days. Stressed plants were reirrigated and the recovery was studied for 7 days. Control plants were irrigated daily maintaining soil water content at about field capacity. Stem water potential, relative water content, leaf mass area, chlorophyll stability index, drought injury index, and rapid test for drought tolerance were measured in fully expanded young leaves. On the basis of above indices, these cultivars were screened and categorized as tolerant and susceptible. The results suggest that Deym and Sabz are more drought tolerant than Siah and Shah. We concluded that although these indices will be useful to rapidly screen for drought tolerance, however for an efficient screening program they are not sufficient.

1. Introduction

Drought is one of the critical environmental stresses that affect the establishment, survival, growth and performance of shrubs and trees (Fernández et al., 2006). Plants experience drought stress either when the water supply to roots becomes difficult or when the transpiration rate becomes very high. These two conditions often coincide under arid and semi-arid climates (Reddy et al., 2004).

Water stress tolerance is seen in almost all plant species but its extent varies from species to species (Chaitanya et al., 2003). These variations in response to stress among genotypes offer opportunities for selecting plants with optimal characteristics for high rates of photosynthesis and productivity (Niu et al., 2008). Plants express various responses to drought stress and develop a wide range of mechanisms from morphological to physiological aspects. For example the mechanisms developed by some fruit trees to survive water deficits included reduction in growth rate, stem elongation, leaf expansion and orientation and stomata movements (Jung, 2004). Gradual decrease of photosynthetic rate and stomatal conductance with increasing drought stress is a specific response of some adaptive plants such as almond species (Romero et al., 2004; Gholami and Rahemi, 2009). In many plants net accumulation of osmotically active solutes allows turgor-dependent processes to continue to some extent under water stress conditions. The compounds involved in this osmotic adjustment differ widely (Patakas et al., 2002). Many plants can protect themselves by synthesizing antioxidants such as ascorbate and glutathione and enhancing antioxidative enzymes such as peroxidase. Reactions of plant antioxidant systems upon drought have been intensively investigated for several crop plants (Munné-Bosch and Peñuelas, 2004; Sircelj et al., 2005; Müller et al., 2006).

Considerable research has been undertaken on the physiological and molecular mechanisms involved in drought adaptation. However, there is no comprehensive standard system for measuring drought resistance, especially because the physiological model approach is not always adequate for selection because of negative correlation between physiological traits involved in drought adaptation (Turner et al., 2001). Breeding crops would seem possible by using substitute measurements of water use efficiency in the field or using a crop growth model, but these field studies are costly, time-consuming and affected by environment variations. On the other hand, data on early physiological or growth changes obtained under controlled conditions are more precise than field results (Clavel et al., 2005).

There is always a need for easier-to-use and reliable water stress indicators (Thakur, 2004). These easy to use methodologies are handy tools in the hands of scientists to understand the intrinsic ability of an individual crop plant to undergo quick adjustment under water stress conditions. Thakur (2004) hypothesized that these indices are highly useful to rapidly screen any number of fruit crops for drought tolerance at all phenological phases. Water stress induced by consecutive years of drought constitutes a major constraint for fig (*Ficus carica* L.) production in Iran. Iran is one of

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0304-4238/$ – see front matter © 2012 Published by Elsevier B.V.
http://dx.doi.org/10.1016/j.scienta.2012.05.012