

SALINITY STRESS

Response of Sorghum to Abiotic Stresses: A Review

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Abstract

Sorghum [(*Sorghum bicolor* L.) Moench] is a highly productive crop plant, which can be used for alternative energy resource, human food, livestock feed or industrial purposes. The biomass of sorghum can be utilized as solid fuel via thermochemical routes or as a carbohydrate substrate via fermentation processes. The plant has a great adaptation potential to drought, high salinity and high temperature, which are important characteristics of genotypes growing in extreme environments. However, the climate change in the 21st century may bring about new challenges in the cultivated areas. In this review, we summarize the most recent literature about the responses of sorghum to the most important abiotic stresses: nutrient deficiency, aluminium stress, drought, high salinity, waterlogging or temperature stress the plants have to cope with during cultivation. The advanced molecular and system biological tools provide new opportunities for breeders to select stress-tolerant and high-yielding cultivars.

Introduction

Sorghum [(*Sorghum bicolor* L.) Moench] is a multipurpose crop belonging to the Poaceae family, which are C4 carbon cycle plants with high photosynthetic efficiency and productivity. Sorghum is one of the five major cultivated species in the world because it has several economically important potential uses such as food (grain), feed (grain and biomass), fuel (ethanol production), fibre (paper), fermentation (methane production) and fertilizer (utilization of organic by-products). Sorghum originates from Africa, from the southern region of the Sahara Desert, where several closely related wild species are found (Legwaila et al. 2003). The cultivated genotypes and hybrids are very diverse. In the European Union and in the USA, sweet sorghum has been bred as a promising energy crop (Berenji and Dahlberg 2004), and it is also suggested as a candidate for biofuel production in hot and dry (arid) countries, such as Nigeria, India, Australia or Mexico (Almodares and Hadi 2009). It is an important cereal in Africa, the Middle East, Asia and Central America and is a principal source of food for millions of people. The purpose of breeders in China is to develop genotypes of both high grain yield and high sugar content in the stem juice. Germplasm resources

of sorghum show that a competition exists between grain yield and stem biomass production, and the task of the breeders is to find the optimum conditions for the different productivities in the plants. Breeding strategies for adaptation of sorghum to climatic variability have been excellently reviewed by Hausmann et al. (2012).

Morphological and Physiological Characteristics of Sorghum

The plant is native in tropical areas and is also well adapted to temperate climate. It is highly resistant to drought (Steduto et al. 1997), salinity (Almodares et al. 2008a,b) as well as water logging (Promkhambut et al. 2010), and it can be grown and can maintain remarkable yield potential in environments that are normally too extreme for other C4 plants. Some of its morphological features are advantageous for the acclimation to specific abiotic stresses.

The height of the plants ranges from 1.5 to 3.0 m, depending on the number and length of the internodes as well as on the length of the peduncle and the panicle. Tillers may develop from the lower nodes, while lateral branching may occur higher up on the stem. In adult plants, lateral branches usually develop when a significant amount of