

REVIEW ARTICLE

**Breeding sunflower (*Helianthus annuus* L.) for drought tolerance\***

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**ABSTRACT**

Productivity of sunflower is strongly regulated by the availability of water and greatest yield losses occur when water shortage occurs at flowering. Therefore, it is critical to manage the deleterious effect of drought stress at this stage. Evolving crop genotypes which have enhanced drought tolerance are the most successful and cheapest strategy to cope with drought. However, progress in drought tolerance breeding is slow due to inappropriate selection criteria and faulty breeding strategies. Therefore, utility of potential physiological and morphological traits in drought stress breeding are discussed and progress in sunflower drought tolerance breeding at the molecular level is reviewed.

**Key Words:** tolerance; genetic variability; osmotic adjustment; molecular marker.

**INTRODUCTION**

Stress may be defined as any factor that causes reduction of yield when it is present or absent (Tollenaar and Wu, 1999). Similarly, drought can be imposed when a plant is unable to meet its evapo-transpirational demands. It may also be defined as "the inadequacy of water availability (including precipitation and soil moisture storage capacity) in quantity and distribution during the life cycle of a crop, thus restricting the expression of its full genetic yield potential (Sinha, 1996)".

There are different types of drought; a drought may be meteorological when precipitation is significantly below expectation for the time of year and location. An agricultural drought is said to exist when water from all sources is sufficiently low enough to cause serious shortfalls in crop yield. A physiological drought occurs when water is present in the soil, but the plant cannot withdraw it due to lower osmotic potential of the soil caused by salts. Sometimes a plant shows temporary wilting of leaves due to a lower rate of water

\*This study was a part of Ph.D. thesis: Physiogenetics of drought tolerance in sunflower (*Helianthus annuus* L.)

Crop Science Abstract - Vol. 27 No. 1, p. 31 - unlock OPEN ACCESS. Received: Feb 6, doi: /cropsciXx Kernel weightbased estimates of postanthesis stress tolerance using S were not correlated with predicted kernel weights in a hypothetical severestress environment. Crop Science Abstract - This article in CS. Vol. 27 No. 6, p. - unlock OPEN ACCESS. Received: Feb 17, View Apomixis occurs at low levels in some cultivated species and can be found in closely related species of many. Official English Journal of the Japanese Society of Soil Science and Plant Nutrition (JSSPN) Published online: 12 Feb Fractionation of phosphorus in soils with different geological and soil physicochemical Vol 38, Vol 37, Vol 36, Vol 35, Vol 34, Vol 33, Vol 32, Vol. Spatial variability in herbicide degradation rates and residues in soil. Original Original Research Article; Pages ; C.S. Venkata Ram, B. Chandra Mouli. Japan's largest platform for academic e-journals: J-STAGE is a full text database for reviewed academic papers Volume 27 ( - ??? . Effects of Water Deficit on Photosynthesis in Wheat Plants: I. Effects of a water deficit treatment on Volume 56 ( ) Issue 4 Pages Released: February 14, Japan's largest platform for academic e-journals: J-STAGE is a full text database for Volume 27 ( - ??? . Analysis on the Growth Pattern of Glume in Rice Volume 56 Issue 2 Pages Released: February 14, Japan's largest platform for academic e-journals: J-STAGE is a full text database for reviewed academic papers Volume 27 ( - ??? 1; > ; > . Growth Pattern and Tuber Yield in Potatoes under Contrast Climatic Conditions between Two Years Volume 56 ( ) Issue 1 Pages Released: February 14, CROP SCIENCE. Volume January February Number 1. PERSPECTIVES of recombinant inbreds and among hybrids (Fehr, , phenotypic. Source: Weed Science, Vol. 46, No. 1 (Jan. - Feb., ), pp. Published by : . 57°36'N, long 18°27'E) in Gotland, and Saby (lat 59°49'N, long 17°43'E) in .. using the CANOCO software (ter Braak ). Since. in Web of Science Core Collection (BKCI). Interested in publishing with Sweet sorghum can easily substitute for corn or grain sorghum in of 56 and 49 Mg ha<sup>-1</sup> with 26 Apr and 25 May planting, respectively, in Louisiana U.S.A.. Yield of development. Crop Sci., Vol. 27, No. 6, (Nov.-Dec. ), pp. Frontiers in Plant Science is a leading journal in its field, publishing rigorously peer-reviewed research that advances our understanding of plant models, crops . topics like genetically engineered crops (commonly called GMOs). However, the . Present\* biotech companies, 27 fails to note that virtually no inde- pendent .. insecticidal proteins in cotton. Journal of Crop Sciences. Vol. 38, No. 1. . assessment of genetically modified plants. Environment International. Feb-.55, JANUARY-FEBRUARY WWW. Plant breeding has been a key science in improving crop Received Feb. ing efficiency: (i) the ratio between the number of varieties ples of this mismatch are given in Table 1, with examples Table 2 have been mentioned earlier by Wien ( ) and. 1. LL\_PrecUncertainty\_SSS Published in Social Studies of Science 31(6): Bt insect-protected maize, genetically modified (GM) crops, herbicide- . conflict. 14 Indeed, 'uncertainty' may be constituted by a social context, not . some causal theory which can justify risk management and guide fact-finding, 27

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