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Initiation of a pre-breeding effort aimed at water stress resistance traits for yield improvement in wheat

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Hexaploid bread wheat (Triticum aestivum L.) and tetraploid durum (Triticum durum) are major wheat cultivars accounts about 95% and 5% respectively of the world production. SA is sitting on the 28th position on countries ranking and contributes 0.24% of global wheat production, however production decreased by 5.8% in year 2013 to 2014 (Index mundi: Wheat production by country in 1000 MT, 2015), due to ever increasing world population (2.3% annually); the demand for food increases. By year 2050, prospect demand for food anticipated to escalate up to 60%, therefore, crop improvement is important to secure food security (FAO). Wheat production is affected by a number of biotic and abiotic factors. Water stress is a major abiotic factor hampering wheat production and other crops and continues to be the challenge in plant breeding. In developing countries water stress severely affect about 50% of wheat production areas and 70% of developed countries. Nezhadahmadi et al., in 2013 presumed that approximately 1.8 billion people could encounter utterly water scarcity and 65% of the world's population could reside under scarce water environments. Breeding for diseases and water stress resistance under semi-arid to arid regions, thereby improving yield are main objectives in plant breeding programs. According to Blum et al., in 1981; genetic improvement of tolerant varieties desire more attention on relevant physiological water stress tolerant mechanism as a selection criteria. Therefore selection criteria by means of plant physiology mechanism are significant for improving productivity. It is postulated that by incorporating potential individuals can lead to the progress of the plant breeding program. Crossing male and female segregating base population as parental lines previously proved to be improved yield, utilizing MS-MARS scheme were made as part of MS-MARS cycle one. Sixty genotypes were screened for water stress resistance utilizing reticulated hydroponic system (RHS). Screening was divided into two sections, 45 genotypes were screened on each section including 15 controls. The experiment was conducted in a growth chamber at Stellenbosch, Welgevallen Experimental Farm. The temperatures of the growth chamber were 18oC. Plants were grown under infrared UV light calibrated as long day length. Five seeds were planted in each PVC column followed by thinning to one plant after 16 days. First week irrigation was manual using standard nutrient solution, followed by programmed timer installed into RHS and three pulses were timed per day. Stress was applied by withholding water supply after 20 days for 14 days. During stress period leaf length, number, rolling, yellowing, drying, tiller and side shoot development were evaluated. The RWC of all genotypes was calculated using protocol by Barrs and Weatherley (1962).

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