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Original Research Article

Screening of Wheat Varieties (*Triticum aestivum* L.) under Natural Salt Stress Condition for Yield and Yield Related Traits

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A B S T R A C T

A field experiment was conducted for the screening of the wheat varieties Kh-65, PBW-343, KRL-210, KRL-19, HD-2733 and K-9006 under natural saline soil at the Main Experiment Station (MES) of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P). The pH and EC of the field soil was 9.4 and > 4mmos respectively. Agronomic practices were followed as per recommendation of wheat crops. Soil salinity severely affected growth and yield of wheat varieties. The stay green duration, days to 50% flowering, number of grains per spike, grain yield, test weight and biological yield of wheat crop highly reduced irrespective of wheat varieties. The wheat varieties PBW-343, K-9006 and HD-2733 highly susceptible to salinity stress while Kh-65, KRL-210 and KRL-19 maintained its growth and yield under natural stress conditions.

Keywords

Tolerance, Stress, Wheat, salinity, Yield

Introduction

Wheat is the major cereal crop in many parts of the world. It is commonly known as king of cereals. It belongs to poaceae family and genus triticum. Wheat consist second position in both area and production after rice in India (Torech and Thompson, 1993). Wheat crop faces among the number of abiotic stresses salinity is importantant ones in many part of India.

Saline soils have soluble salts that are responsible for lowering plant yield (Munns and James, 2003). Approximately 12 million hectare agricultural land nationally are alkali (sodic in nature). Eastern U.P. itself have 23000 hectare land of problematic situation in arid region salinity and sodicity posses a great problem for developing new salt tolerant varieties with sustainable yield. In U.P. there are 1.29 million hectare agricultural land are alkali/sodic in nature (QRT- report 2012 of All India co-ordinated wheat and Barley improvement project i.e. AICWBIP). There is an estimated annual loss of 12 billion US dollars to the world economy due to salinity, and it is still on rise (Lauchli and Luttge, 2004). Such a large salt-affected area and economical loss is a matter of concern for farmers who face a decline in their income due to this problem. Moreover, population growth, urbanization, industrialization, and climate Change including salinity creates an alarming situation that poses a threat to national and international food security. Possible solutions include increasing the area under wheat cultivation, which is not possible, and developing varieties that give a good yield on marginal lands like saline soils (Sobhaniana *et al.* , 2011).

The soil salinity may cause several deleterious effects on growth and development of plants at physiological and biochemical level (Munns, 2002). These effects can be due to low osmotic potential of soil solution, specific ion effects, and nutritional imbalances or combined effect of all these factors (Marchner, 1995., Zalba and Peinemann, 1998). High concentration of salts have detrimental effects on germination of seeds and plant growth . Many investigators have reported retardation of germination and growth of seedlings at high salinity . However plant species differ in their sensitivity or tolerance to salts (Kumar *et al.* , 2012)**.** Soil salinity is one of the major abiotic stresses affecting germination, crop growth and productivity. Crop yields start declining when pH of the soil solution exceeds 8.5 or ECe value goes above 4 dS m^{-1}. At higher ECe values the crop yields are reduced so drastically that crop cultivation is not economical without soil amendments. Addition of salts to water lowers its osmotic potential, resulting in decreased availability of water to root cells. Salt stress thus exposes the plant to secondary osmotic stress, which implies that all the physiological responses, which are invoked by drought stress, can also be observed in salt stress. Salinity has negative impact on water and nutrient uptake because of osmotic and ionic imbalance. This will produce plants with reduced height, less leaves and tillers as well as reduced yield (Asgari *et.al.*, 2012). Since salinity is complicated trait and genetically controlled, plants show different response when they grown under salinity stress according to their genes content (Gupta and Huang, 2014).

Salinity tolerance is a complicated trait which is controlled by polygenes and their expressions are influenced by various environmental elements (Flower, 2004). This means that breeding for this trait is so difficult. Tolerance to salinity stress is a complicated parameter in which crop's performance can be influenced by several characteristics (Ingram and Bartels, 1996). Many factors can affect plant responses to salinity stress such as plant genotype, growth stage, severity and duration of stress, physiological process of growth, different patterns of genes expression, activity of photosynthesis machinery, metabolic pathways and molecular levels (Gupta and Huang, 2014 and Mathur *et al*. , 2007). New molecular 'omic' tools have generated major interest among researchers and opened up new perspectives in stress biology (Shavalli *et al.* ,2007).While transcriptomic approaches are an important resource, functional gene expression profiles can only be achieved by proteomic analysis. Furthermore, proteins undergo significant levels of post-translational modification of their primary sequences followed by targeted proteolysis. Thus, quantitative analysis of gene expression at the protein level is essential for determining plant responses to salt stress. Expression profiling at the protein level represents the core of proteomics approaches (Parker *et al.* , 2006).

Materials and Methods

Six wheat genotypes Kh-65, PBW-343, KRL-210, KRL-19, HD-2733 and K-9006 were sown at Student Instructional Farm and MES of Narendra Deva University of Agriculture and Technology Kumarganj, Faizabad in Rabi season 2016-17. The treatment of salt stress was given by sowing in saline soil having pH 9.8 and EC > 4 mmohs on the same date as that of control. General Agronomics practices were followed as per requirements of crop. Days to 50% flowering was recorded from date of sowing to 50% flowering. Chlorophyll content as SPAD value was recorded with the help of chlorophyll meter. Plant height was recorded from base of plant to base of spike of five plants and average out to one. Number of grain spike $^{-1}$ were recorded by selecting main spike of five plants and average out to one as considered grains spike^{-1} . Grain yield of five plants randomly selected were taken at maturity and average out to one as grain yield in gram per plant. Test weight was recorded by randomly counting 1000 seeds and weighted in gram as test weight per plant.

Results and Discussion

Total chlorophyll content (SPAD) highly reduced irrespectively of wheat varieties (Fig.1). High reduction chlorophyll content was recorded in PBW343, HD2733 and K9006 while less reduction was recorded in K65, KRL 19 and KRL210.

Chlorophyll content reduced due to less absorption of nitrogen, magnesium, and iron due to saline stress and affects the metabolism of chlorophyll synthetic activity (Kumar *et al.* , 2012)

Salinity stress reduced the plant of all wheat varieties (Fig.2). The maximum reduction in plant height was recorded in PBW 343 while less in K 65 and KRL 210. The soil salinity disturbs the metabolic activity of plants that responsible for growth and development. It reduces the nutrient absorption and assimilation due to low osmotic pressure (Munns, 2002).

Days to 50% flowering significantly affected by salinity stress (Fig.3). Flowering days increased in PBW343, HD2733 and K9006) while K65, KRL 210 and KRL 19 were less affected. Salinity stress reduces vegetative growth and phenological development due disturb metabolism (Gupta and Huang, 2014).

Fig.1 Effect of salinity stress on chlorophyll (SPAD) value of wheat varieties under salinity stress

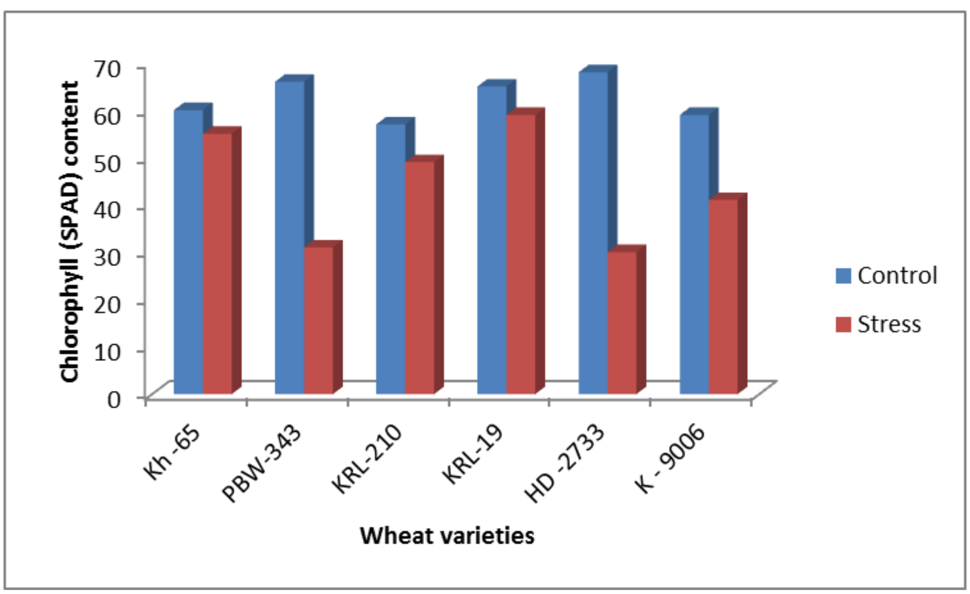


Fig.2 Effect of salinity stress on plant height (cm) of wheat varieties

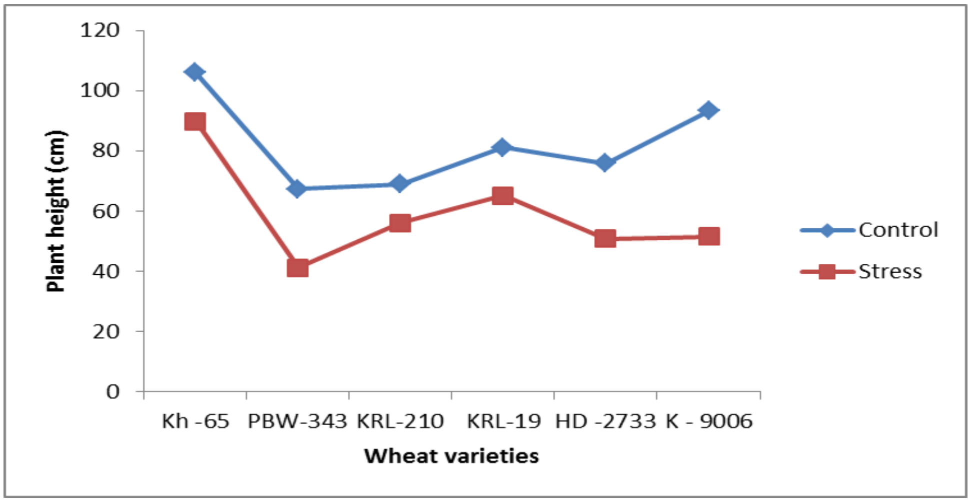


Fig.3 Effect of stress on days to 50% flowering of wheat varieties under salinity stress

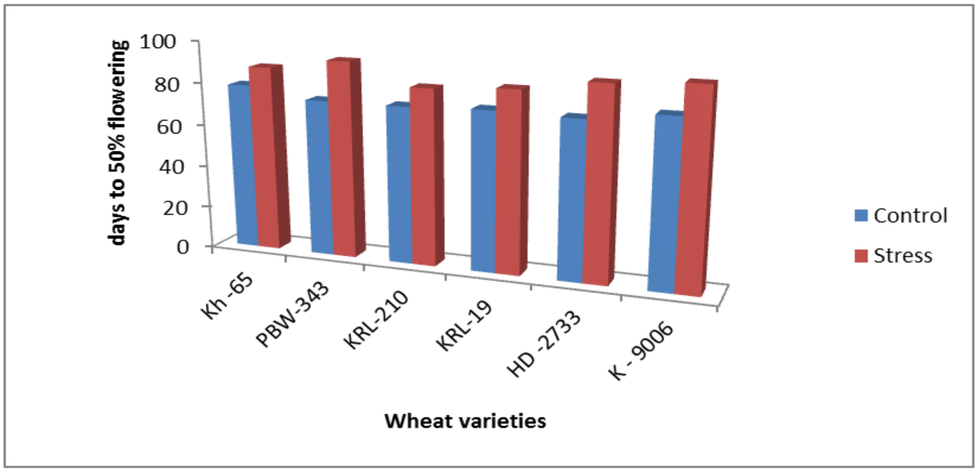


Fig.4 Effect of stress on number of grains per spike of wheat varieties under salinity stress

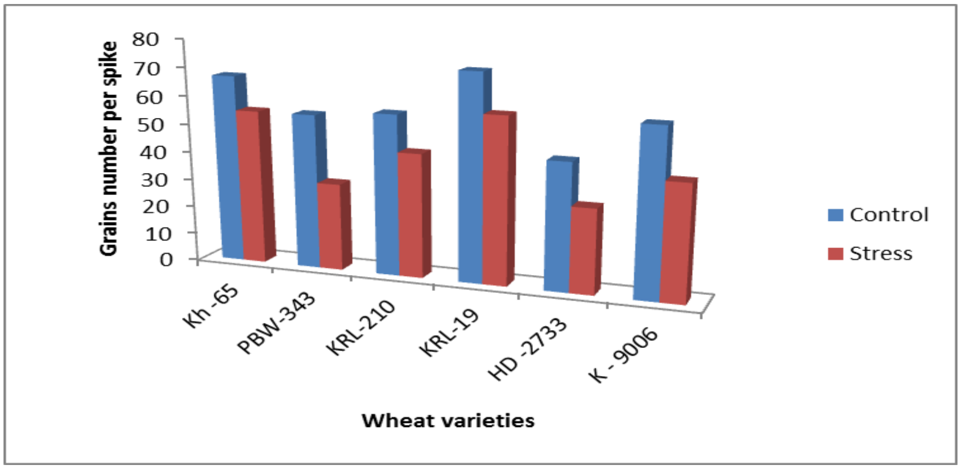


Fig.5 Effect of stress on grains yield (g) per plant of wheat varieties under salinity stress

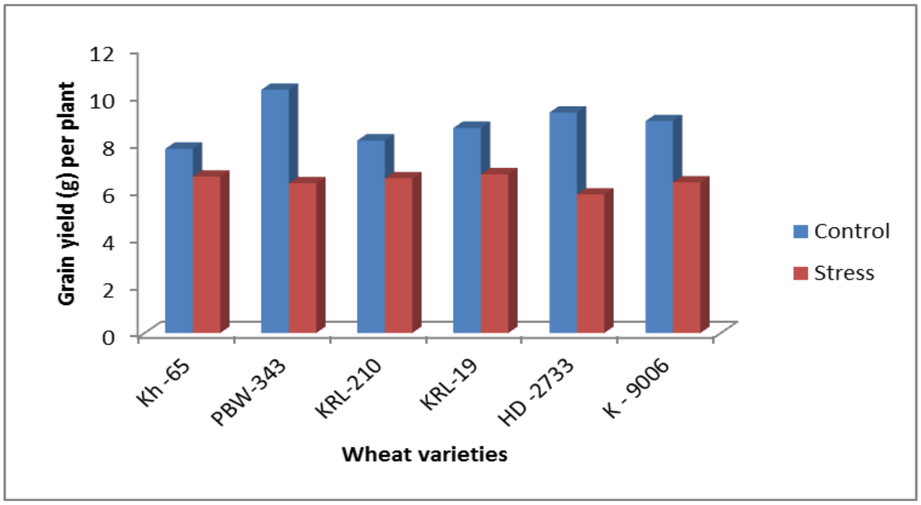
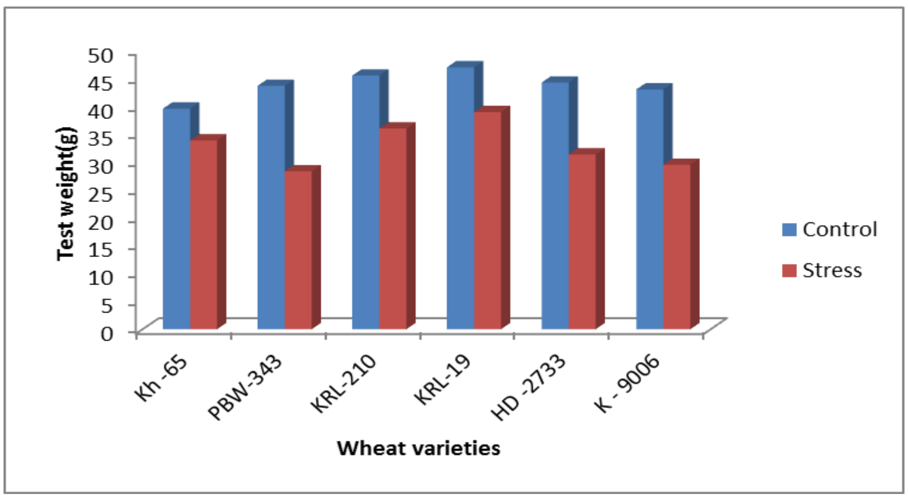


Fig.6 Effect of stress on test weight (g) per plant of wheat varieties under salinity stress



Spike length, number of grains, grain yield and test weight of wheat varieties markedly reduced in wheat varieties under salinity stress condition (Fig,4, 5, and6). High reduction in yield and yield components was recorded in PBW 343, HD 2733, and yield and yield components due reduced growth, vegetative development, and biomass accumulation in salinity stress condition (Sobhaniana *et al.* , 2011, Munns, 2011).

In conclusion, salinity stress reduced the growth and development and chlorophyll content of wheat varieties under salinity stress condition irrespective of wheat varieties. High reduction in chlorophyll, yield and yield components were recorded in PBW 343, HD2733 andK9006 while less reduction was recorded in K65, KRL 210, and KRL 19 while less in K65 and it long stay green duration.

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