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Seed pre-treatment with thiourea improves physiological and metabolic adaptation to booting stage salinity in wheat

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Introduction

- Salinity as a growing problem worldwide affects 20% of cultivable land, with up to 50% production losses [1, 2].
- As a leading staple crop, one-third of population consumes wheat daily for 20% of total caloric intake, however, salinity affects its growth, reducing yield and produce quality. Instead of moderately salt tolerant, about 60% wheat yield declines under saline conditions at a threshold of ≈6-8 dS m-1 [2].

Methodology

- The present pot study was conducted under open wire house condition exposed to natural growing conditions. The seed of wheat cv. Faisalabad-2008 were soaked at different levels (0.1, 0.2, 0.3 and 0.4 mM) of thiourea (TU) including water soaked and untreated seed as controls. For seed priming, each of the TU concentrations and water-soaked seed were immersed in respective concentration solution and water for 6 h. For soaking, the seed weight to solution volume ratio was kept 1:5 at room temperature. After treatment, seed was rinsed with distilled water thrice and surface dried to their original dry weight under shade. After pre-treatment, control and TU treated wheat seed (5 in each) were sown in pots filled with the homogenized soil (5 kg) and completely randomized in factorial design
- . At the booting stage, salinity shock was imposed on wheat plants by adding salt solution of 120 mM NaCl. After 20 days of salinity treatment, flag leaf was collected and three wheat plants from each replicate were uprooted for growth, biochemical and ionic measurements in respective flag leaf, root and shoot by standard procedures.

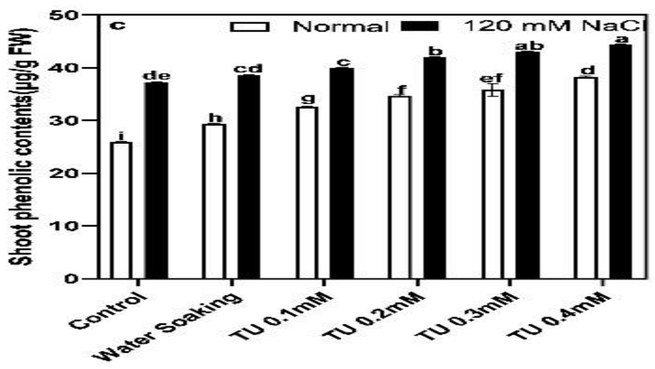

Figure 1: Plant height (cm) affected by (a) salinity (b) thiourea treatments (c) their interactions in wheat at booting stage

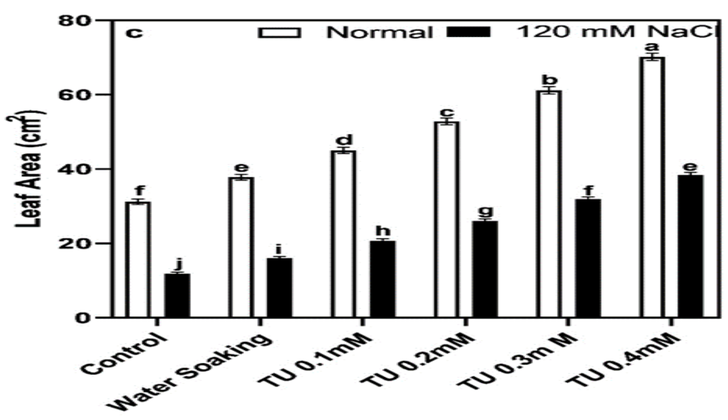

Figure 1: Leaf area (cm2) per plant affected by (a) salinity (b) thiourea treatments (c) their interactions in wheat at booting stage

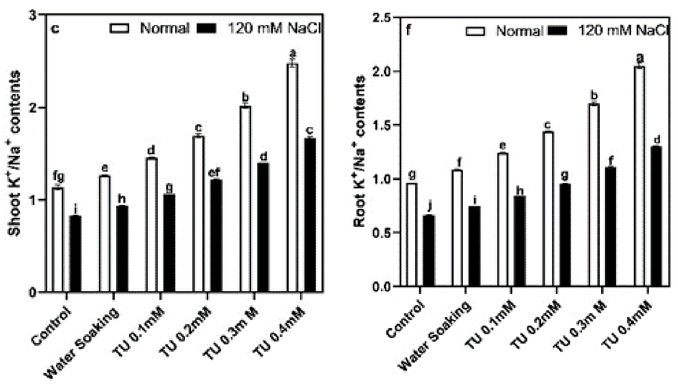

Figure 2: K+/Na+ ratio in shoot and root affected by ((a, d) salinity (b, e) thiourea treatments (c, f) their interactions in wheat at booting stage

Results and Discussion

- Salinity reduced the growth in terms of plant height, LA and total dry weight per plant in wheat of present study (Figures: 1.
- Under saline condition, high soluble Na+ and Cl- concentration inhibits growth of different plant organs due to physiological moisture stress interfering with nutrient and water absorption .
- Consequently, decrease in osmotic potential of soil creates ion toxicity and nutritional imbalance which reduces the meristematic activity and cell elongation process in the shoot axis affecting leaf appearance and expansion rate, tiller numbers and LA in wheat.

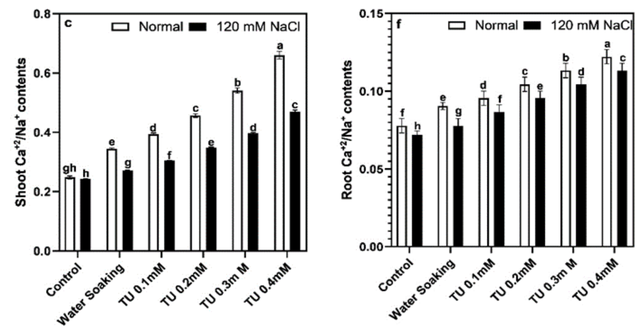

Figure 3: Ca2+/Na+ ratio in shoot and root affected by (a, d) salinity (b, e) thiourea treatments (c, f) their interactions in wheat at booting stage

Conclusions

- Salinity stress at booting stage reduced the growth, flag leaf photosynthetic pigments, uptake of essential inorganic (K+, Ca2+, nitrates, phosphates and sulphate) nutrients, while, induced accumulation of shoot MDA and H2O2 levels, Na+ uptake and secondary metabolites in shoot and root of wheat plant of present study. These inhibitory effects of salinity were alleviated
- by seed pre-treatment with 0.3 mM or 0.4 mM TU associated with increased accumulation of K+, Ca2+, nitrates, phosphates and sulphate nutrients and further increase in synthesis of secondary metabolites in shoot and root of wheat plants contributing towards increased growth and leaf chlorophyll contents. In crux, the increased metabolic adaptation to salinity by TU seed pre-treatment was attributed to decrease in shoot MDA and H2O2 levels, decreased Na+ uptake, increased secondary metabolites and inorganic nutrients in shoot and root contributing towards nutrient balance and tissue tolerance at booting stage in wheat plant.

References

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