Fayoum University
Faculty of Science
Botany Department

Attenuating the adverse impacts of drought stress in some plants by using a multi-biostimulator

By

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6. Summary and Conclusion

Wheat and tomato are two of the most important crops, which play a special role in people's nutrition. They have a significant role in food security in our country. But unfortunately abiotic stresses, such as water limited stress (S-LW), decrease their growth and productivity.

S-LW is strongly phytotoxic partly because of the generation of reactive oxygen species (ROS) that damage organic molecules or inhibition of antioxidants system in plants.

To overcome the problems rose from S-LW stress on plant growth intensive efforts have been directed by many investigators towards developing techniques that could mitigate the drastic effects on plants. The interactive treatments of S-LW stress and biostimulators are one of the techniques recommended in alleviating the adverse effects of S-LW on plant growth.

So, in this investigation, we observe the changes that might take place in, growth and some related physiological activities of wheat and tomato plants after being subjected to S-LW stress and soaking wheat grains or spraying tomato transplants in maize grain embryos-derived natural extract enriched with gibberellic acid, ascorbate, and selenium (MEEst). Results obtained could be summarized as follows:

1- In both plants S-LW ($IR_{60\%}$) caused a considerable decrease in WUE, photochemical (PhChem) activity, Fv/Fm, PI, SPAD, total carotenoids, chlorophyll-a (Chll−a), and chlorophyll-b (Chll−b) compared to full irrigation ($IR_{100\%}$). Under full irrigation and S-LW conditions, the 15.0% MEEst treatment increased all the parameters mentioned above in comparison to the corresponding control.
2- Both plants exposed to S-LW showed significant reductions in the contents of N, P, K, Fe, Mn, Zn, and Se in comparison to fully

irrigated plants. Regardless of irrigation levels, applying 15.0% MEEst markedly increased the nutrient contents compared to untreated plants.

3- In both plants, S-LW significantly decreased RWC and MSI, and increased EL, MDA, H_2O_2, and $O_2^{\bullet-}$ contents compared to well watering. However, applying 15.0% MEEst elevated both RWC and MSI, while minimized EL, MDA, H_2O_2, and $O_2^{\bullet-}$ contents compared to the control.

4- In both plants, S-LW significantly increased the contents of the osmoprotectants (soluble sugars, free proline, and glycine betaine), while decreasing total soluble protein. Nevertheless, under different irrigation regimes, the application of 15.0% MEEst increased the contents of osmoprotectants. For osmotically-stressed plants, 15.0% MEEst elevated soluble sugars, free proline, glycine betaine contents, and total soluble protein.

5- In both plants, the contents of non-enzymatic antioxidants [glutathione (GSH), ascorbic acid (AsA), and α-tocopherol (α.TOC)], were significantly increased under the irrigation level of $IR_{60\%}$ compared to well-watered plants. However, under full irrigation and S-LW, application of 15.0% MEEst substantially elevated the non-enzymatic antioxidants. Under S-LW, for both plants, treatment with 15.0% MEEst increased the non-enzymatic antioxidants in relation to the corresponding control, and markedly exceeded those obtained under full irrigation ($IR_{100\%}$) treatment.

6- In both plants, the contents of enzymatic antioxidant activities [superoxide dismutase (SOD), glutathione reductase (GR), catalase (CAT), and ascorbate peroxidase (APX)] were significantly increased under the irrigation level of $IR_{60\%}$ compared to well-watered plants. Under full irrigation, exogenously-applied MEEst increased the activities of SOD, CAT, GR, and APX compared with the respective

control. Under S-LW, for both plants, treatment with 15.0% MEEst increased the antioxidant activities in relation to the corresponding control, and markedly exceeded those obtained under full irrigation ($IR_{100\%}$) treatment.

7- Water limitated-stressed both plants exhibited lower phytohormone contents (IAA, GA_3, zeatin-type cytokinins (Z-CK), and CKs), and higher ABA content than non-stressed plants. However, treatment with 15.0% MEEst to full irrigated and stressed plants showed higher IAA, GA_3, Z-CK, and CKs contents, and lower ABA content than untreated plants.

8- S-LW significantly decreased growth traits of both plants (Plant leaf area, plant leaf number, plant shoot length, plant root length, plant shoot fresh weight, plant shoot dry weight, plant root fresh weight, and plant root dry weight) compared to the control. However, application of 15.0% MEEst notably increased all growth traits compared to the corresponding control.

9- in comparison to F-IV, S-LW significantly reduced the wheat yield components, such as plant branches number, spike grain number, 100-grain weight, and pot grain weight. The 15.0% MEEst treatment, however, significantly increased all tested wheat yield components under the F-IV and S-LW treatments. On the other hand, under S-LW, tomato shows a discernible drop in the plant fruit number, plant fruit weight, and fruit average weight in comparison to F–IV. The 15.0% MEEst treatment, however, significantly increased all tested tomato yield components under the F-IV and S-LW treatments.

10- In wheat, S-LW significantly decreased crude fiber content, starch content, grain N content, grain P content, and grain K content, while increasing ß-carotene content, total sugar, and grain hardness when compared to F-IV. The 15.0% MEEst treatment, however, significantly improved wheat grain quality traits under the F-IV and

S-LW treatments, with a few minor exceptions. In tomato, WL significantly increased TSS, vitamin C, organic acids, lycopene, firmness, and β-carotene when compared to F-IV, while Se decreased. On the other hand, the 15.0% MEEst treatment under F-IV and S-LW treatments significantly increased TSS, vitamin C, organic acids, lycopene, firmness, β-carotene, and Se.

11- in wheat, S-LW significantly reduced the anatomical traits of the wheat leaf, such as blade thickness, midvien thickness, main vascular bundle diameter, xylem vessel diameter of the main vascular bundle, and epidermis thickness, in comparison to F-IV. On the other hand, under F-IV and S-LW treatments, the 15.0% MEEst treatment significantly increased all wheat leaf anatomical traits. Also, S-LW significantly reduced the anatomical traits of tomato leaves (height of midvein, width of midvein, height of midvein vascular bundle, width of midvein vascular bundle, blade thickness, palisade thickness, spongy parenchyma thickness, and xylem vessel diameter) in comparison to F-IV. The 15.0% MEEst treatment, however, significantly increased all tomato leaf anatomical traits under the F-IV and S-LW treatments.

Conclusion: S-LW induced generally variable changes in the content of some metabolites of both plants. Application of MEEst mitigated the adverse effects of S-LW on growth and some metabolic mechanism of both plants. Also, application of 15.0% MEEst was more effective than application of 7.50% MEEst in almost all growth measurments, physiological determinations, etc…...