Application of Surfactant and Biological Fertilizer on Yield of Corn Under Limited Irrigation Conditions

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Introduction:

- As more water and soil amendments are used in crop production, a more intensive management system is required to conserve the available water as well as guarantee an optimum yield and crop quality in dry regions.
- Soil microorganisms are important in agriculture because of their role in promoting natural fertility and recycling of nutrients in soil and thus reducing the need for chemical fertilizers.
- In many arid and semi-arid areas, water use is unsustainable; and much effort is being made to reduce water use by crops and produce 'more crop per drop'.
- Issues surrounding the availability of water have led to implementation of various agronomic practices and application of chemicals to reduce the irrigation water application for crop production.
- Surfactants or wetting agents are big group of chemical substances which may increase water use efficiency through reducing runoff and improvement of soil water holding capacity

Research Goals:

To investigate the interaction effects of biological fertilizers and surfactant application on corn (*Zea mays* L. SC. 704) growth and development under water deficit stress condition.

Materials and Methods:

Background

This research was conducted in Research Farm of College of Agriculture, University of Tehran, in Karaj/Iran (N35º56", E50 º 58"), in 2011.

The soil texture of the experimental field was Clay loam with pH= 8.2 and EC = 2.41 DS/m.

Treatments

Main Plots: Irrigation regimes

1. Normal irrigation (control); irrigation after 70mm evaporation from standard evaporation pan Class A.
2. Limited irrigation: normal irrigation till 8-leaf stage and then irrigated only at 10-12 leaf stage, initiation of flowering, initiation of grain formation, and finally irrigation at milky grain.

Sub Plots: Water Treatments

1. Untreated water application (control)
2. Water + surfactant application

Sub-Sub plots: Fertilizing Systems

1. Control (no fertilizer application)
2. Complete chemical fertilizer; N, P, and K on the basis of soil test
3. Biological Fertilizer; a combination of pro-biotic Plant Growth Promoting micro-organisms
4. Biological Fertilizer + 25% chemical fertilizer
5. Biological Fertilizer + 50% chemical fertilizer

Surfactant application Rate

The rate of surfactant application was 1 litter per hectare in each irrigation.

Biological fertilizer characterization

The Biological fertilizer was a mixture of P solubilizing and N fixing bacteria including Bradyrhizobium, Pseudomonasan, Nitrosomonas, Azotobacter, Azospirillum, and mycorrhiza.

Results:

- Fertilizer application improved forage yield by 36% in both irrigation systems (Figure 1) and quality (leaf/stem ratio) by 1.04% compared with no fertilizer treatment (Figure 2).
- The integrated application of surfactant and biological fertilizer lead to increase in corn grain yield (Figure 3).
- Application of surfactant improved grain yield. Surfactant moderated the adverse effect of water stress on grain yield (Figure 4).

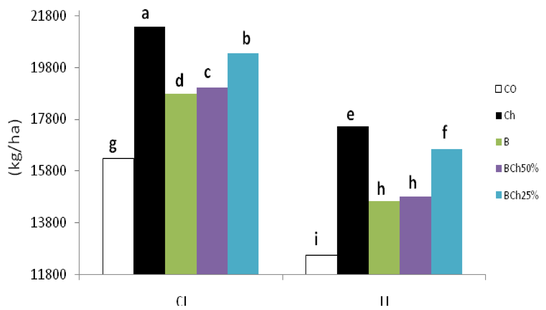

Figure 1. The effect of irrigation regimes and different fertilizer treatments on corn forage yield.
CI: Complete irrigation LI: Limited irrigation

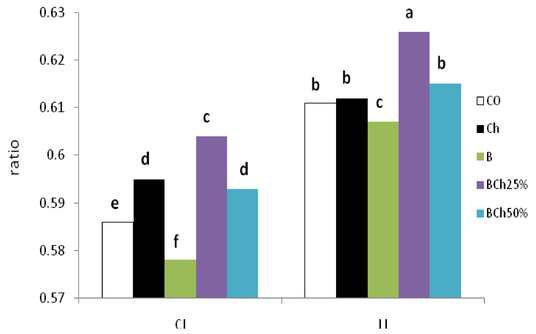

Figure 2. The effect of irrigation regimes and different fertilizer treatments on corn ear plant ratio.

CO: Control CH: chemical fertilizer B: Biological fertilizer
BCH25%: Biological fertilizer+25% chemical fertilizer
BCH50%: Biological fertilizer+50% chemical fertilizer

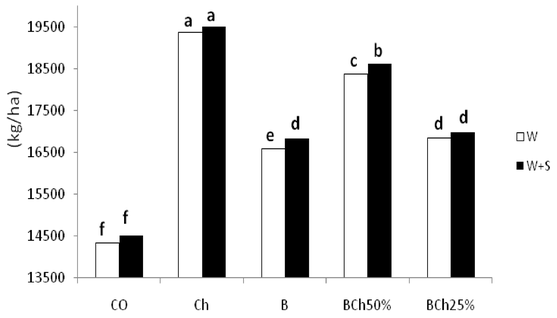

Figure 3. The effect of surfactant and biologic fertilizer on corn grain yield.
W: water W+S: water+ surfactant

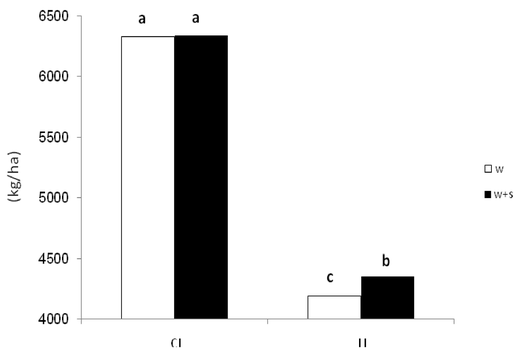

Figure 4. The effect of irrigation regimes and Surfactant on corn grain yield.

Conclusion:

- Biological fertilizers can be used as alternative to chemical fertilizer to some extent. Indeed, these bio-inoculants were adapted to their environment conditions thus this study must be proactive and the field trials must be established across a broad range of soil and environmental conditions and must be conducted within the context of current or future farming practices.
- The results in this experiment cofirmed the compensating role of surfactant in reducing water stress damage in limited irrigation regime. We concluded that surfactants can be useful in optimizing water use in agriculture.

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