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SUMMARY

Sunflower seeds were cultivated under natural condition in the field of Faculty of Science, Tanta University and treated either with cyanobacterial fertilizer or chemical fertilizer (alone) or with different concentrations of their combination [chemical fertilizer (20Kg N/fed.) + biofertilizer (cyanobacteria 500g/fed.), chemical fertilizer (30Kg N/fed.) + biofertilizer (cyanobacteria 500g/fed.) and chemical fertilizer (40Kg N/fed.) + biofertilizer (cyanobacteria 500g/fed.)]. The dose consisting of a combination of both fertilizers [chemical fertilizer (30Kg N/fed.) + biofertilizer (cyanobacteria 500g/fed.)] induced the maximum growth and yield of sunflower plants was detected. Thereafter, sunflower seeds were cultivated in pots under different salinity levels; two salinity levels (0.2% and 0.4% NaCl) were choosen for the rest of the study. In order to check the role of cyanobacterial biofertilizer in reversing the inhibitory effect of salinity, sunflower seeds were cultivated in pots under the impact of the two salinity levels detected earlier in presence of both fertilizers and their combinations.

The impact of chemical and biofertilizer on sunflower growth and yield components is shown by analyzing the data of field experiment results. A combination of chemical fertilizer (30Kg N/fed.) and biofertilizer (cyanobacteria 500g/fed.) significantly increased the values of measured growth parameters such as plant height, stem length, root length, number of leaves, leaf area and number of internodes more than all other treatments. This combination produced also the highest total mean values of fresh and dry weights gained in stem, leaves and roots of sunflower at all ages compared with all other treatments. A significant progressive increase in the total pigment content of sunflower (*Helianthus annuus* L.) in response to addition of chemical fertilizer (30Kg N/fed.) and biofertilizer (cyanobacteria 500g/fed.) at all ages is shown in the obtained results. Application of the recommended dose of biofertilizer only (cyanobacteria 500g/fed.) stimulated higher values of total carbohydrates gained by stem, leaves and root of sunflower (*Helianthus annuus* L.) at all ages compared to all treatments. This is followd by the combination of chemical fertilizer (30Kg N/fed.) + biofertilizer (cyanobacteria (500g/fed.). Chemical fertilizer (30Kg N/fed.) caused a highly significant increase of total of protein content of sunflower gained by all the plant parts.

At harvest time, a significant increase in some of the growth parameters detected in sunflower treated with chemical fertilizer (30Kg N/fed.) + biofertilizer (cyanobacteria 500g/fed.). In addition, some yield components such as 100-seed weight, seed yield/plant and seed yield/fed were significantly increased with the addition of a combination of both fertilizers. Moreover, oil content and the percentage of unsaturated fatty acids [oleic ($C_{18:1}$), linoleic ($C_{18:2}$) and linolenic acids ($C_{18:3}$)] were increased about 14% upon application of the same combination. Application of chemical fertilizer (40Kg N/fed.) and biofertilizer (cyanobacteria 500g/fed.) increased the available nitrogen content in the soil by about 1.4 times. Also, each of chemical fertilizer (30Kg N/fed.) and biofertilizer (cyanobacteria 500g/fed.) increased the available phosphorus by about 1.3 times. In addition, a combination of chemical fertilizer (20Kg N/fed.) and biofertilizer (cyanobacteria 500g/fed.) increased the available potassium by about 1.1% compared to the control.

The impact of chemical and biofertilizer on salinized sunflower growth and yield is shown by analyzing the data of the pot experiment results. Under salinity stress (0.2% and 0.4% NaCl), results indicated that the most marked significant increases in the measured growth parameters in sunflower plants were obtained by the application of chemical fertilizer (30Kg N/fed.) + biofertilizer (cyanobacteria 500g/fed.). Also, a significant increase in the total pigment content was induced with the same combination. Results also showed a significant increase of the total carbohydrates content estimated at all measured ages of salinized sunflower plants with addition of biofertilizer (cyanobacteria 500g/fed.). An increase in total protien content with addition of chemical fertilizer (30Kg N/fed.) at all ages of sunflower was recorded. At harvest time, the results show significant increases in some of the growth parameters such as (plant height, stem length, root depth, number of leaves, leaf area, number of internodes, disc and stem diameters) and fresh and dry weights measured in salinized sunflower treated with chemical fertilizer (30Kg N/fed.) + biofertilizer (cyanobacteria 500g/fed.) compared with other treatments.

The present results indicate that sunflower (*Helianthus annuus* L.) 100-seed weight, seed yield/plant and seed yield/fed were significantly increased with the addition of chemical fertilizer (30Kg N/fed.) + biofertilizer (cyanobacteria 500g/fed.) under both salinity treatments compared with all treatments. Also, the obtained results revealed a significant increase in carbohydrates accumulation and oil content of sunflower seeds with addition of chemical fertilizer (30Kg N/fed.) and biofertilizer (cyanobacteria

500g/fed.). Moreover, results show an increase in protein content of sunflower seeds with addition of chemical fertilizer (30Kg N/fed.) under salinity stress.

The percentage of total unsaturated fatty acids [oleic ($C_{18:1}$), linoleic ($C_{18:2}$) and linolenic acids ($C_{18:3}$)] was increased with the addition of chemical fertilizer (30Kg N/fed.) and biofertilizer (cyanobacteria 500g/fed.) with salinity treatment.

Results indicated that application of biofertilizer (cyanobacteria 500g/fed.) under salinity stress increased the available nitrogen content in soil by about 1.5 times. Also, biofertilizer (cyanobacteria 500g/fed.) and chemical fertilizer (30Kg N/fed.) under 0.4%NaCl increased the available phosphorus by about 2 times. In addition, chemical fertilizer (30Kg N/fed.) under 0.4%NaCl increased the available potassium content in soil by about 1.7 times.

In conclusion, our data indicate the stimulatory impact of the treatment of sunflower plants with the cyanobacterial biofertilizer either alone or in a combination with urea (as a chemical fertilizer) on the measured growth parameters and yield components. Moreover, biofertilizer applications showed a reversible effect on the inhibition caused under the different levels of salinity stress.

A combination of chemical fertilizer (30Kg N/fed.) and biofertilizer (cyanobacteria 500g/fed.) induced the highest degree in reversing the inhibitory effect measured in growth parameters in sunflower plants treated with 0.2% NaCl, followed by biofertilizer alone, then chemical fertilizer. At a concentration of 0.4% NaCl, biofertilizer application came at first followed by the combination of both, then, the chemical fertilizer alone.