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# Roles of organic and bio fertilizers in improving tolerance of different plants to environmental ecosystem

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***Abstract*---**Some important details related to the effects of organic fertilizers and soil microbes on plant morphological, physiological and biochemical characters have been indicated. The role of the most important organic fertilizers and soil microbes on the growth of different crop plants under stress has been presented. Accordingly, research work has indicated that organic fertilizers and the use of soil microbes including bacteria and fungi can positively affect plant characters. Some details are also available on the effect of water stress including drought and salinity on plant morphological, physiological and biochemical characters have been also. Have been illustrated. However, the other important point, which must be researched in greater details, is the interactions of bio and organic fertilizers with stress conditions. If such details are illustrated, it will be possible to produce more tolerant crop plants.

***Keywords*---**roles organic, environmental, ecosystem, fertilizers.

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## Introduction

Abiotic stress such as drought, salt, cold, and heavy metals largely influences plant crop productivity and development. Abiotic stress is a major threat to food security due to the deterioration of environment caused by human activity and constant changes of climate. To cope with abiotic stress, plants can initiate a number of physiological, molecular, and cellular changes to adapt and respond to such stresses. Better understanding of the plant responsiveness to abiotic stress will aid in both modern and traditional breeding applications towards improving stress tolerance.

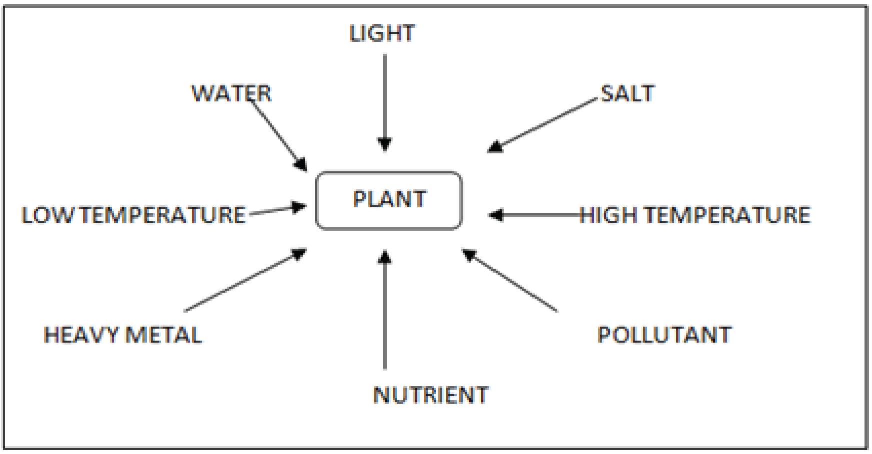

Figure 1: Some types of abiotic stress factors that affect plants life.

## Drought

### Morphological effects of drought stress on crop plants

Drought stress is an important environmental limiting factor of plant growth and establishment. In fact, seed germination is the first stage of growth that is sensitive to water deficit. Therefore, germination of seeds, vigour and length are important for the establishment of plants. Visible symptoms of plant subject to water deficit in the vegetative stage are a decrease in plant height, leaf wilting, decrease in area and number of leaves, and delay in formation of flowers and buds (Bhatt and Srinivasa, 2005 and Soha E. Khalil and Fatma M seleem, 2019, Biswas, 2010, Mansour et al., 2019a-e, Hu et al., 2019, Abdalla et al, 2019, Jiandong, et al, 2019, Abd-Elmabod et al, 2019a-b, Tayel et al 2019a-c, Hellal et al, 2019, Mansour and Pibars 2019, Attia et al., 2019, Pibars and Mansour, 2019, Hellal et al., 2021, Gaballah, et al, 2020, Pibars et al, 2020, Mansour et al, 2020a-d; Mansour and Aljughaiman 2020).

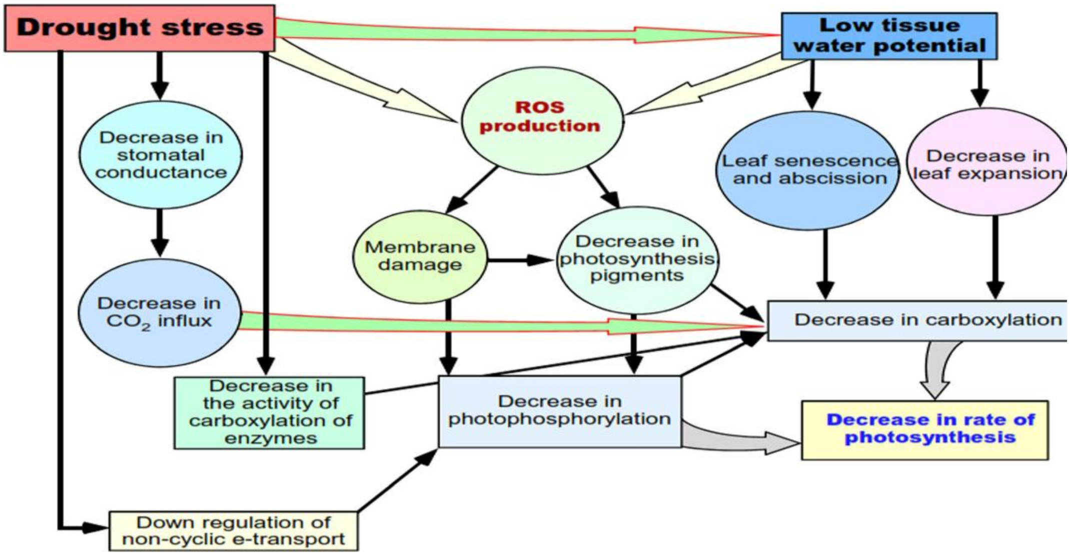

Fig. 2 Influence of drought stress on morphological, physiological and biochemical characters (Farooq *et al.*, 2015)

**Salinity**

**Morphological effects of salt stress on crop plants:**

Salinity causes reduction in germination rate, germination index, seedling length, germination percentage, root /shoot length ratio and seed vigor (Khodadad 2011and Soha E Khalil and Bedour H Abou Leila 2016). Salinity inhibits rapidly stems and leaves growth, whereas roots elongation may increase. Ion toxicity is the primary cause of growth reduction under salt stress (Chinnusamy, *et al.* 2005 and Soha E. Khalil, 2016). Many researchers recorded that plant growth reduced under saline irrigation condition and the degree of growth reduction depended on environmental conditions, level of salt, type of plants and stages of growth. The first effect of salinity on plants is reduction in its growth as a result of reduced osmotic potential which inhibits absorption of water and nutrients by stressed roots (Jose *et al.,* 2017). Shoot and root growth reduction are more obvious and causes extreme, necrosis, chlorosis, and senescence of young and old leaves (Munns, 2002 and Soha E. Khalil 2016). Salinity has also been found to alter the root system morphology and decrease the plant total root length (Álvarez *et al.*, 2014). A general reduction in fresh and dry weights has been recorded in most plant tissues exposed to salinity, and it is especially noticeable in the shoot system. Different researchers have revealed the reduction in fresh and dry weights to the decrease in the number of leaves or in leaf abscissions (Soha E. Khalil and Ashraf M. Khalil, 2015) . Another typical response to salt stress is a reduction in total leaf area (Jose *et al.,* 2017). The reduction in the leaf area might be considered as a resistance mechanism that minimizes the loss of water through transpiration (Ruiz-Sánchez *et al.,* 2000). Increasing salt concentration in irrigation water limiting leaf area, caused plant growth reduction, and changing the relation between root and the aerial parts. Salinity stress makes different crop plants showed drier root mass than shoot, causing increase in root to shoot ratio

(Fernández-García *et al.,* 2014 and Taha B. Ali, Soha E. Khalil and Ashraf M. Khalil, 2011).

**Physiological effects of salt stress on crop plants:**

Photosynthesis process is the most important process in which green plants make their own food, they convert solar energy into chemical energy and produced organic compounds and oxygen by carbon dioxide fixation. Photosynthesis is adversely affected by salinity in different ways, such as the inhibition of $CO_2$ fixation and concentration due to stomatal closure, the reduction or destruction of photosynthetic pigments including carotenoids, chlorophyll a andchlorophyll b (Qados 2011), and damage to photosynthetic processes (photosystems I and II, and electron transport (Sudhir *et al.* 2005). The reduction in photosynthesis process due to salinity resulted from reduction in chlorophyll concentration and content. Total photosynthesis rate declined due to decrease in leaf characters such as reduction in leaf expansion and development, as well as increase in leaf abscission, increase the exposure to salinity caused, membrane disruption, complete stomatal closure, ion toxicity, become the prime factors responsible for photosynthetic inhibition. Generally, the total carotenoid and chlorophyll contents of leaves are decrease under salinity stress where the chlorosis start from oldest leaves during the salt stress conditions (Farooq *et al.,* 2015 and Taha B. Ali, Soha E. Khalil and Ashraf M. Khalil, 2011).

Salt stress suppressed the leaf water relations including relative water content percent, turgor potential, osmotic potential, water potential, water relation parameters, as well as plant growth, and plant fresh weight, (Jabeen and Ahmad 2012 and Soha E. Khalil and Bedour H. Abou Leila, 2016 ). There are two issues:

i) In high salt concentration, plants accumulate more $Cl^-$ and $Na^+$ ions in leaves than normal situation that cause decrease in leaf osmotic potentials and resulted in more negative water potentials.
ii) Root hydraulic conductance reduction causes decrease in the amount of water flow from the roots to the leaves, causing water stress in the leaf tissues.

Many amino acids including proline, arginine, alanine, glycine, leucine, serine, and valine, amides (asparagines and glutamine) and the non-protein amino acids (ornithine and citrulline) accumulate in plants exposed to salt stress (Torabi *et al.,* 2010). In addition, Hussain *et al.,* (2016) indicated that the accumulation of total free amino acids higher in leaves of salt tolerant than in salt sensitive lines. The increased accumulation of soluble carbohydrates and reducing sugars in plants has been highly recorded as a response to salinity or drought stress, a significant reduction in net $CO_2$ fixation, concentration and assimilation rate reported as consequence to soluble carbohydrates accumulation (Murakezy *et al.,* 2003and Soha E. Khalil, 2016). Parvaiz and Satyawati (2008) recorded that when glycophytes are exposed to high salinity level, the increase in soluble sugars reached to about 50%, which increase in osmotic potential. Parida *et al.* (2002) showed that carbohydrates content such as polysaccharides like starch and mono and disaccharides like (glucose, sucrose, and fructose,) accumulate under saline conditions and play a major role in osmotic regulation, osmoprotection, carbon storage, and radical scavenging.

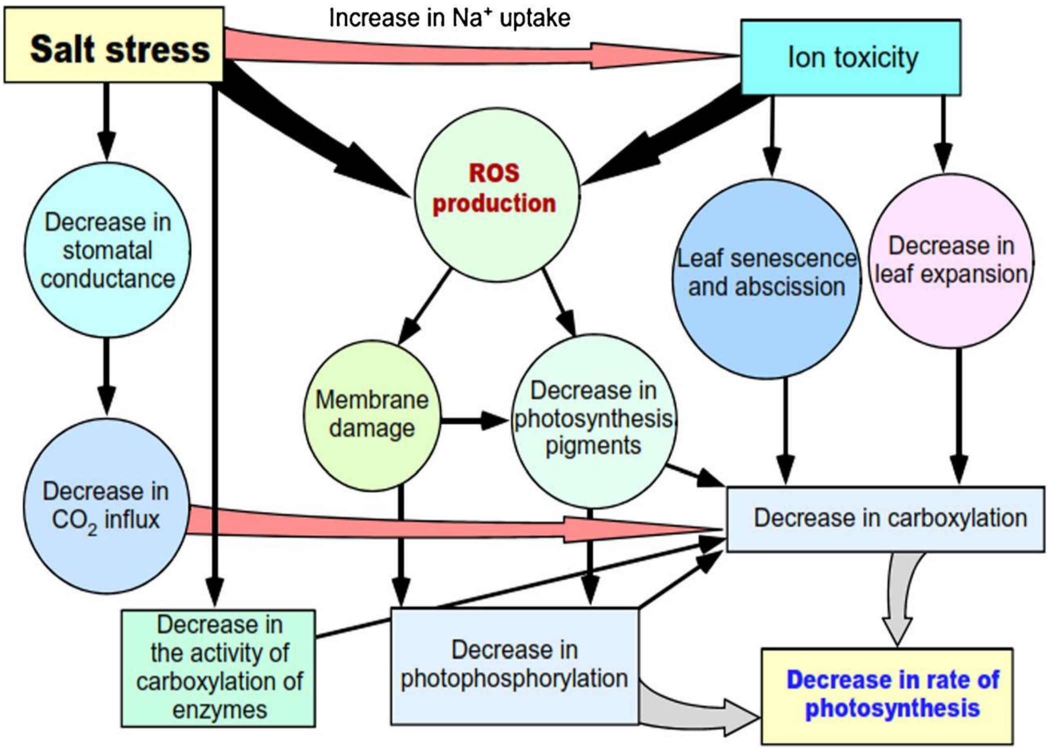


Fig. 3: Influence of salt stress on physiological and biochemical characters in plant cells. Farooq *et al.* (2015).

**Stress Alleviation by using Soil Microbes or Bio fertilizers:**

Production of tolerant crop plants under stress conditions can increase by different methods, including the use of soil microorganisms (biofertilizers), which seems to be effective on the increasing tolerance of different crop plants under stress conditions. Plants have complex mechanisms to tolerate abiotic stresses caused by various ecological factors, including salinity and drought. Plant associated microbe (including bacteria and fungi) in the soil alleviate the adverse effects of stresses in a more cost-effective and time sensitive manner. Research directed towards the application of bio-fertilizers in salt and drought-affected fields, which encourages commercialization of inoculants for stress resistance (Babalola, 2010 and Rabia M.M. Yousef, Soha E. Khalil and Nadia A.M. El-Said, 2013).

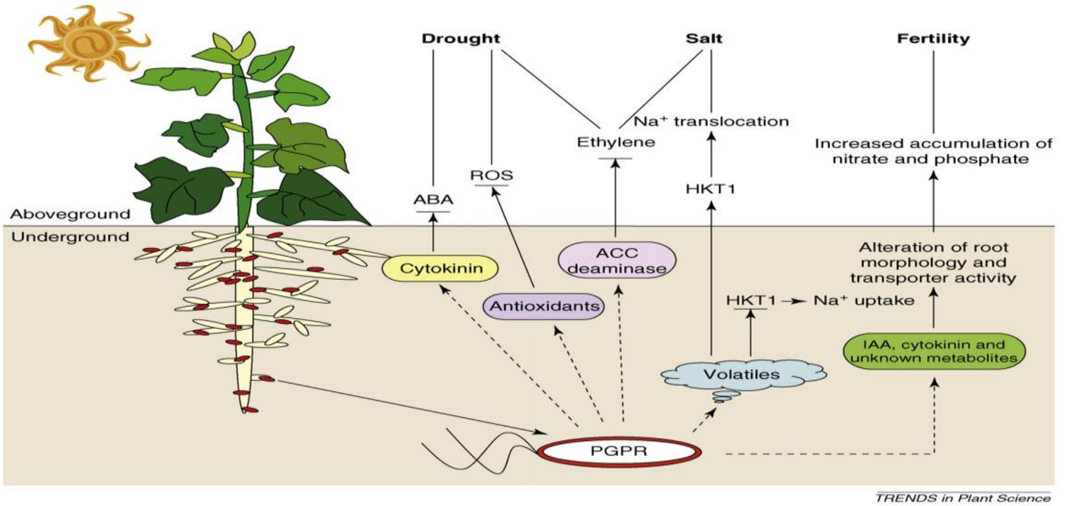


Fig 4 : Rhizosphere bacteria help plants tolerate to abiotic stress(Yang,2009**).**

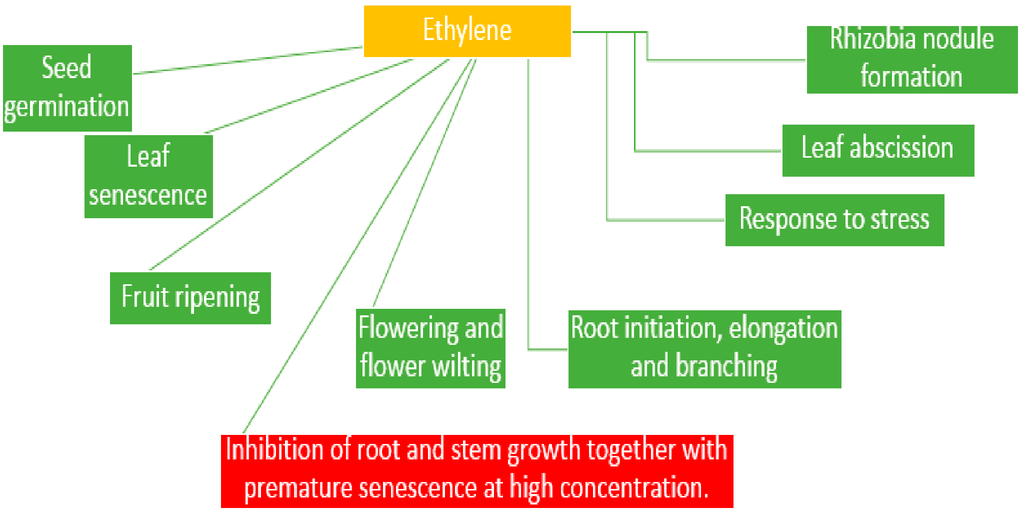


Figure 5: Ethylene hormone affects several processes in plant (Vejan *et al.,* 2016)

**Effect on stress tolerance:**

Inoculation plants with bio-fertilizers have been known to induce abiotic stress regulation either by direct or indirect methods that increase plant tolerance to stress conditions. Root system is the major part that induced plant response to stress condition. The following mechanisms illustrate how the symbioses may help plant under stress conditions. (1) The bacteria produce cytokinin, causing an increase in production of ABA in plant. (2) Bacterial produced antioxidants that scavenge the formation of ROS or reactive oxygen species in plant. (3) The emission of volatiles compounds by which bacteria affects the translocation of $Na^+$

and its uptake by plant. (4) The secretion of exo-polysaccharides that improve the soil properties and fertility. (5) The bacteria can produce indol acetic acid IAA and some growth regulators, which improve root development under different conditions including stress (Yang *et al.,* 2009).

Microorganisms alleviating stress effect by the following mechanisms: (1) activation of different stress enzymes, (2) inducing systemic resistance in the host plant, and (3) formation of different metabolites such as amids, proline, amonia and polysaccharides (Yuan et al., 2010 and Soha E. Khalil and Rabie M.M. Yousef, 2014). The microorganisms are able to alleviate the badly effects of stress on plant development and yield productivity by different morphological, physiological and biochemical adaptation.

**Stress Alleviation by using organic fertilizers:**

Organic fertilizers are fertilizers deriving from biological or living plant or animale materials. The major advantages of organic fertilizers include improved soil water retention, soil texture, and soil resistance to erosion. Organic fertilizers protect plant from different types of diseases by enhancing plant tolerance and by meeting the plants nutritional needs. This action alleviates a serious effect of stress (Sharma and Ronak, 2017and Soha E. Khalil and Rabia M.M. Yousef, 2014).

**Effect on morphological characters:**

Several studies have done to alleviate the effect of abiotic stress on cellular damage and to improve different plant crops tolerance against stress, among of which the applications of organic fertilizers (Suja and Sreekumar, 2014 and Soha E. Khalil and Ashraf M. Khalil, 2015. Also it may be due to the activation of different species of living organisms which release important growth regulators or phytohormones like auxin, gibberellins or cytokines also it may stimulate the plant growth and absorption of nutrients, or due to the increase in the increase in water use efficiency by different crop plants (Suja and Sreekumar, 2014). In addition, Cha-um and Kirdmanee (2011) stated that the organic matter application in paddy fields (EC 8.5–20.4 $dSm^{-1}$) could effectively alleviate the problem of soil salinity, also resulting in yield improvement. Similar results were obtained by Soha E. Khalil and Rabia M.M. Yousef, 2014 and Soha E. Khalil and Ashraf M. Khalil, 2015.

**Effect on plant physiological characters:**

The reduction in chlorophyll accumulation under stress conditions is mainly due to the reduction in peroxidase, chlorophylls enzyme activity, and phenolic compounds, resulting in chlorophyll degradation (Ramírez, *et al.,* 2014 ). They suggested conservation of better photosynthetic capacity, associated with more plants resistance and organic treatment which increased photosynthesis efficiency in treated plants. In accordance Soha E. Khalil and Rabia M.M. Yousef, 2014 and Soha E. Khalil and Ashraf M. Khalil, 2015 obtained similar results.

**Effect on plant biochemical characters**

It has been reported that organic fertilizers application could improve N uptake by plants even under water deficit stress conditions caused by drought or salinity stress (Guo *et al.,* 2016). Therefore, it is reasonable that improved nutrient uptake NP and K by using organic fertilizers has been considered as a practical approach for amplifying resistance in different cop plants. Furthermore, Wang *et al* (2003) reported that potassium could increase the sucrose-phosphate synthase activity and the accumulation of soluble protein content in *Oryza sativa* flag leaf, also it increased the accumulation of grain protein. In relation, Salehi *et al.* (2016) stated that treated plants with 10 t/ha vermicompost showed less stress effect and induced a significant impact on chlorophyll, proline, carbohydrate and nutrient uptake in German chamomile. Also, Morard *et al*., (2011) reported that organic compounds proved improved the mineral nutrition, better efficiency of plant water uptake and grain protein and carbohydrates content of different crops. Similar findings obtained by Soha E. Khalil and Rabia M.M. Yousef, 2014 and Soha E. Khalil and Ashraf M. Khalil, 2015.

**Conclusion**

Some important details related to the effects of organic fertilizers and soil microbes on plant morphological, physiological and biochemical characters have been indicated. The role of the most important organic fertilizers and soil microbes on the growth of different crop plants under stress has been presented. Accordingly, research work has indicated that organic fertilizers and the use of soil microbes including bacteria and fungi can positively affect plant characters. Some details are also available on the effect of water stress including drought and salinity on plant morphological, physiological and biochemical characters have been also Have been illustrated. However, the other important point, which must be researched in greater details, is the interactions of bio and organic fertilizers with stress conditions. If such details are illustrated, it will be possible to produce more tolerant crop plants.

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