

EFFECT OF SALINE STRESS ON GROWTH OF FRUIT PLANTS (REVIEW ARTICLE)

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ABSTRACT

Soil and irrigation water salinity are among the main problems hindering agricultural development, especially in arid and semi-arid regions, which depends on especially surface irrigation as the main means in agriculture. The salinity lead to low growth and production of plants, including fruit, as a result of the temporal, azalotic, or nutrients imbalance. Salinity of the soil or irrigation water greatly reduces the growth, productivity and quality of fruit crops by affecting their physiological, chemical and biological functions as they cause obstruction to the absorption of some elements by the plant and if it increased absorption of salts, it causes ion poisoning of the cell, as well as increased salts cause less absorption of water by the plant due to the high osmosis of soil water. There are many ways to reduce the salt stress in the growth of fruit plants, the most important of which is adding organic fertilizers such as humic acid or spraying with the amino acid proline.

Keywords: Salt Stress; Effect; Fruit; Growth; Nutrients.

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INTRODUCTION

The stress is caused by the exposure of the plant to adverse and Salt stress: abnormal external conditions and has a clear impact on growth and production. The salinity of the soil and irrigation water is one of the most important environmental challenges that affect the growth of fruit crops, especially in arid and semi-arid regions, as they cause a marked decrease in vegetative and fruitful growth. (Ashraf and Harris, 2004). Salinity is the high level of salt in the soil, which causes the accumulation of excess salts and is usually more visible to the surface of the soil or the high concentration of total salts in the soil to a level that adversely affects the growth of plants. In general, Salinity is the availability a large number of chemical compounds in the soil for some mineral salts such as chloride, calcium, magnesium The amount of).or sodium sulfate, which is called soil salt (Aras and Esltken, 2019 soluble salts present in the soil varies from one soil to another and this is due to the conditions of soil formation and type of soil, and in general the rate and kind of soil salinity represents a specific role to determine the possibility of cultivation this soil with the crops that can be grown, due to its negative and large effects on most agricultural crops, including fruit crops (Soni *et al.*, 2017).

Also, the accumulation of salts in the root zone leads to a momentary effect on nutrients inside the cell due to inhibition of the absorption of necessary elements

such as K^+ , Ca^{2+} and NO_3^{-1} (Munns and Tester, 2008), which leads to a lack of elements and then concentrate sodium and chloride with toxic levels in the cells, and confirmed this Grattan and Grieve (1999) that any imbalance of nutrients when planting in saline soils or irrigation with salty water leads to a lack of some elements, including nitrogen, phosphorus and potassium as a result of the high concentration of chloride and sodium that compete to enter the tissues of plants causing an imbalance of nutrients, as well that higher concentration of salts in soil lead to drying of the roots because the soil salts draw water from these roots (Parida and Das, 2005).

Salinity, sources and physiological roles:-

Ibrahim (2011) mentioned that the sources of salinity can be the result of one or more of these reasons:

1. The salts present in the soil resulting from the continuous dissolution and erosion of the rocks (the parent soil).
2. The high level of ground water resulting from the absence of good drainage after irrigation.
3. Interference of sea water with groundwater, especially in the lands adjacent to the coastal areas.
4. Soluble salts added through irrigation and fertilization.

Salinity, already one of the most acute plant growth stresses, is becoming an even more serious concern as world desertification on the increase. Under saline conditions, growth reduction, nutrient imbalance and ion toxicity are caused by high Na^+ and Cl^- concentrations. More ways used to avoid or reduce loses in plant production caused by adverse soil salinity (Winkler *et al.*, 1974; Nijjar, 1985). As a result of the change in climate conditions, soil salinity has increased dramatically, especially with the use of unsuitable quality for watering plants or as a result of not using irrigation programs, especially in orchards. Studies have shown that salinity has a harmful effect on plant growth and development, and this negative effect is often associated with a change in environmental conditions prevailing in the region (high temperatures, low air humidity and intensity of lighting) as these conditions cause great damage if combined with high salinity (Grattan *et al.*, 2015; Nikolskii-Gavrilov *et al.*, 2015). As for fruit trees, their growth decreases due to a decrease in the absorption of water by the roots or the bad effect of the rise of some elements, especially sodium and chlorine, and the high osmotic pressure, all because of the effects of high salinity in the orchard. There are many chemical, physiological and anatomical changes that may appear on the plant at high salinity in the soil, perhaps the most important of which is the high absorption of elements such as chlorine and sodium from the root system to the branches of the plant, which negatively affects the photosynthesis process and thus negatively affects plant growth. (Ben Ahmed *et al.*, 2009; Singh and Reddy, 2011; Anjum *et al.*, 2011; Goltsev *et al.*, 2012; Abdallah *et al.*, 2018).

A major biochemical alteration, An apparent increase in the production of free radicals, nitrogen oxide, active hydroxyl groups, active oxygen, or active carboxylate groups, and these free radicals have negative effects for cell membranes, photosynthesis and nucleic acids (Gill and Tuteja, 2010; Boguszewska and Zagdańska, 2012; Proietti *et al.*, 2013; Ozgur *et al.*, 2013; Bose *et al.*, 2014).

Free radicals resulting from the effect of salt stress also greatly interfere with the action of proteins, polysaccharides, lipids, and nucleic acids. Which leads to disturbance in the work of cells and their nutritional transformations (Nath *et al.*, 2016), which is reflected in the growth, in addition to that the increase in the content of sodium and chlorine ions in chloroplast affects the synthesis and activity of enzymes (Proietti *et al.*, 2013), and the decrease in its transfer to the foliage of the plant, in contrast, there is a clear increase in the synthesis of hormones that inhibit the synthesis and action of chlorophyll, which leads to leaf chlorosis or de-greening or yellowing (Keunen *et al.*, 2013).

One of the most important biochemical content that affects plants under salt or water stress conditions is their content of amino acid "proline", which has a close relationship in the mechanism of plant resistance to stress conditions, and it is known that the content of proline increases and rises under stress conditions in order to protect the plant from these conditions (Warren, 2014). From proline and its increase in its accumulation to a decrease in its oxidation on the one hand or from increased protein catabolism and its conversion to amino acids, including proline (Ayala-Astorga and Alcaraz-Meléndez, 2010). Proline plays a very important role in protecting plant tissues under conditions of salt stress contributes to binding and restricting toxic elements absorbed under these conditions (Hayat *et al.*, 2012; Abdallah *et al.*, 2018).

It has been found that the extent of agricultural lands affected by high salinity increases around the world, due to both natural phenomena and agricultural practices, especially irrigation systems where salinity constitutes a major threat to plant growth through the osmotic effect and imbalance of nutrition, hormonal and enzyme balance, as well as the toxic effect of ions, which leads to significant damage occurs to the different physiological and metabolic processes of plants, as the harmful effect of salinity on an entire plant level can be observed with its death and low productivity (Allakhverdiev *et al.*, 2000).

It has been shown that the concentration of salts in the ion exchange process in the soil, such as calcium and sodium affects the chemical and physical properties of the soil, and the high percentage of mutual sodium leads to blocking soil pores and slow water permeability and poor ventilation of the deep soil, which makes the soil unproductive and negatively affects the growth of the developing plant In it. The results of studies showed that salinity affects the absorption of water and nutrients and the physical and chemical properties of the soil, therefore leads to a decrease of plant productivity, and that the increase in the concentration of salts in the medium of growth leads to a decrease in the efficiency of Photosynthesis process, leading to dry and fall leaves (Munns and Tester, 2008).

Effect of saline stress on the growth of fruit plants:-

Several studies indicated that salinity greatly reduces the growth, productivity and quality of fruit crops by affecting their physiological, chemical and biological functions, as osmotic stress in the first stage of salinity stress causes various physiological changes, such as rupture of membranes, an imbalance in nutrients, and a decrease photosynthesis activity (Ferguson *et al.*, 2002), decrease in transpiration efficiency as a result of influencing the opening and closing of stomata, and high salinity also causes a decrease in the concentration of proteins,

total carotenoids, chlorophyll, dissolved sugars and starch contents in fruits (Bonomelli *et al.*, 2018).

The effect of salts on plants, including fruit trees, increases during dry and hot climates, as the effect of salts often appears in deciduous fruit trees in the late summer, while it appears in late winter and early spring in evergreen fruit trees, and the results of studies have shown that fruit plants growing in salty soils or watered with salty water that is small in size, the color of the leaves is bluish green with an increase in the percentage of greenness due to an increase in the percentage of chlorophyll, an increase in the thickness of the kyotical layer on the leaves, the leaf is peeled and colored brown or yellowed or bent (Fu *et al.*, 2013). Fruit trees differ in their degree of tolerance to salinity, and on this basis, they are divided into three groups:

Salinity trees (2-4) mm cm ⁻¹	Salinity tolerant trees (4-8) mm cm ⁻¹	Salinity tolerant trees (8-16) mm cm ⁻¹
Pears, apples, oranges, plum, almonds, apricots, peaches, avocados	Pomegranate, fig, olive, grape	Banana, date palm

Source (Ibrahim, 2011).

Several scientists, including Akça and Samsunlu (2012), Hajiboland *et al.*, (2014) and Koulimboudi *et al.*, (2014) have demonstrated that saline stress has an inhibitory effect on growth in fruit trees and this inhibition may be due to the following reasons:-

1. An increase of salts concentration in the planting medium causes lack of water absorption by plants.
2. A decrease in all activities of nutritional transformations in plant cells.
3. A clear deficiency in the cellular activity, as well as a clear decrease in the elongation of the cells.
4. A clear increase in the rate of cell respiration, which consumes a large portion of energy.
- 5- Cells do not perform their usual functions, thus demolishing the developing plant cells.
- 6- Lack of supply of cells and tissues with their basic needs of nutritional transformations.
7. Increasing the salts in the soil leads to a clear decrease in cell division and elongation.
8. An apparent deficiency in the absorption of micronutrients.
9. Shortness of leaves age, yellowing and dead spots are appeared on the leaves as a result of the accumulation of toxic salts in the tissues of the leaf.
10. A clear deficiency in the leaf area and consequently a decrease in the efficiency of the optical building process.
11. An apparent decrease in the concentration of activated plant hormones with an increase in salts.

12. Activation of photosynthesis occurs under conditions of salt stress, which leads to the speed of demolitions of the photosynthesis pigments in chlorophylls, especially under conditions of lack of water content due to stress.

13. The apparent deficiency in carotene content was observed under conditions of salt stress.

14. An increase in salinity reduces the plant's content of reducing sugars while increasing the content of non-reducing and soluble sugars as a result of inhibition of enzyme activity.

Effect of saline stress on vegetative growth characteristics:-

Several studies had shown that saline stress negatively affects the vegetative growth characteristics of fruit trees by reducing the number of leaves, growth and leaves area, as salts lead to inhibition of activities leading to the production of gibberellins and cytokinins responsible for forming shoots and branches in the plant (Bastam *et al.*, 2013; Hajiboland *et al.*, 2014). In addition, salinity affects in nutritional balance inside and outside the plant, which negatively affects its growth, on the other hand salinity leads to an increase in the accumulation of sodium and chloride ions with toxic concentrations that negatively affect the development of the leaves primordia in active apical meristem, which leads to miscarriage of leaves formation as they cause a shrinkage of the plant cell as a result of the lack of absorption of the nutrients necessary for the division and elongation of cells, in addition to the salinity activating the action of growth-blocking hormones such as abscisic acid and ethylene responsible for aging and leaf fall as they activate the synthesis of cellulose-analyzing enzymes and pectin that dissolve the middle plate in the fall zone (Munns and Tester, 2008; Nooghi and Mozafari, 2012).

In addition to that Increased salt concentration in the soil may lead to a higher osmotic effort that reduces water absorption by the plant as well as a decrease in the bulging effort of stem cells, which led to less cell elongation and then the plant height rate decreases, as the accumulation of salts reduces the levels of chlorophyll pigment in the leaves of plants due to the increased concentration of sodium that inhibits the activity of the enzymes responsible for forming the chlorophyll molecule (David and Nilsen, 2000; Ramoliya and Pandey, 2003).

Effect of saline stress on the root growth characteristics:-

The results of many experiments indicated that the characteristics of root growth (length and number of roots and dry and soft weights of the root system) were negatively affected as a result of saline stress and that's mean a decrease on the biomass of the roots (AL-Absi *et al.*, 2003; Liu *et al.*, 2012). The roots depth and spread in the soil were affected negatively by salinity and accumulation of salts ions in the soil, and perhaps the decrease of the growth characteristics of the root system is due to the decrease in the characteristics of vegetative growth with salt levels rising (Zhu, 2001; Sairam and Tyagi, 2004).

Reducing roots ability to absorb water due to the effect osmotic and ionic effects of saline. The salinity effects of root growth may be attributed to accumulation of sodium and chloride ions with toxic concentrations that lead to death of skin cells of roots and the cells of cortex and thus damage the roots and weak their ability to absorb the necessary nutrients for growth, which reflects

negatively on the growth characteristics of the root system (Chartzoulakis *et al.*, 2002).

Effect of saline stress on the leaves content of nutrients:-

The results of many studies showed that increasing the concentration of salinity in the soil and irrigation water leads to a significant decrease in the leaf content of nutrients, especially nitrogen, phosphorus, potassium, iron, zinc (Vigo *et al.*, 2005), this may be due to the occurrence of an ionic antagonism phenomenon between Na^+ and NH_4 ammonium ion on the one hand and the chlorine ion Cl^- and the nitrate ion NO_3^- on the other hand, or perhaps due to the osmotic effort and water tightness that affect the root growth and thus the limited absorption area of necessary nutrients for growth from the soil (Maathuis and Amtmann, 1999; Carvajal *et al.*, 2002).

Also, the salinity increases the soil alkalinity, which increases the stabilization phosphorus in a soil and low readiness for absorption by the roots, and the salinity increases damage to the plasma membrane by the oxidative stress that attacks the plasma membrane lipids and loses its selection property to become the most concentrated ions in the soil (such as chlorine and sodium ions) are the most absorbed by the plant (Ashraf and Harris, 2004; Hajiboland *et al.*, 2014), in addition to the lack of some elements such as potassium, for example, may be explained as a result of a competition between potassium and sodium on the absorption sites, this causes a decrease in potassium concentration in the plant tissue as a result of the ionic effect of the sodium when its concentration inside the cell increases, or it returns the accumulation of salts in the root zone causes oozing stress, which in turn inhibits the absorption of potassium and then leads to a decrease in potassium in the plant tissues (Tabatabaei, 2006).

تأثير الإجهاد الملحي على نمو نباتات الفاكهة (مقالة مرجعية)

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الخلاصة

تعتبر ملوحة التربة ومياه الري من بين المشاكل الرئيسية التي تعيق التنمية الزراعية وخاصة في المناطق القاحلة وشبه القاحلة، والتي تعتمد بشكل خاص على الري السطحي كوسيلة رئيسية في الزراعة، تؤدي الملوحة إلى انخفاض نمو وإنتاج النباتات بما في ذلك الفاكهة نتيجة عدم التوازن المائي أو العناصر المعدنية، تقلل ملوحة التربة أو مياه الري بشكل كبير من نمو وإنتاجية وجودة محاصيل الفاكهة من خلال التأثير على وظائفها الفسيولوجية والكيميائية والبيولوجية لأنها تسبب إعاقة امتصاص بعض العناصر من قبل النبات وإذا زادت من امتصاص الأملاح فإنها تسبب التسمم الأيوني للخلية، وكذلك زيادة الأملاح تقلل امتصاص الماء من قبل النبات بسبب التناضح العالي لمياه التربة، وهناك طرق عديدة لتقليل الإجهاد الملحي في نمو نباتات الفاكهة، وأهمها إضافة الأسمدة العضوية مثل حامض الهيوميك أو الرش بالحامض الأميني البرولين.

الكلمات الدالة: الإجهاد الملحي، تأثير، الثمار، نمو، العناصر الغذائية.

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