THE EFFECT OF SALINITY ON NUTRIENT AVAILABILITY AND UPTAKE IN CROP PLANTS

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Abstract

Crops are influenced by many climatic and environmental factors that can be of abiotic and biotic factors and they respond directly to changes in temperature, CO_2 concentration, moisture, light intensity, condition of the soil, and so on. Salinity is a major factor that reduces plant growth and productivity throughout the world. Salinity usually occurs when high concentration of soluble salts is present in soil and water; it mainly occur in arid or semi-arid regions as well as in coastal regions. Excessive salts damage plants by disrupting the uptake of water by plant roots and by interfere with the uptake of competitive nutrients. It is well known that nutrient availability and uptake by plants are influenced by salinity. Some soil and plant factor influence nutrient uptake and availability. This review provides an update about soil factors and plant factors that affect nutrients availability and uptake. Soil factors such as soil pH and water availability have a significant role in controlling nutrients availability and uptake. Regarding plant factors, plant species vary in how well they tolerate saline soils; some plants will stand high levels of salinity while others cannot stand salinity. In addition, plants differ in their salinity tolerances depending on the plant growth stages. Physiologically, salinity may have negative impact on many processes, but the most important impacts are in the form of reduced cell growth and decreased leaf area, biomass and yield.

Keywords: Salinity; Crops Soil Factor; Plant Factors; Nutrients.

Introduction

Salinity is a major factor reducing plant growth and productivity throughout the world. Food and Agriculture Organization (FAO) expected that over 800 million hectares would be affected by salinity, considering it as a major limitation to food production for a gradually increasing population (Rengasamy, 2006; FAO and ITPS, 2015). Recent tendency and future demographic projections propose that it is important to produce more crops, which require effective use of salt affected land and saline water resources. Irrigation accounts for almost 70% of all freshwater usage in the world (FAO and ITPS, 2015). Qadir et al, found that at least 20 percent of the world's irrigated land is salt affected and/or irrigated with saline waters (Qadir et al., 2008; Shrivastava and Kumar, 2015). In addition, additional of about two million ha of cropping land are affected by salinity every year (Rengasamy, 2006; Munns and Gilliham, 2015). Because of salinization increase among agriculture land, it is projected that about 50% loss of cropping acreage will be by the middle of the 21st century (Shahbaz and Ashraf, 2015). In arid and semi-arid regions, high temperatures during summer cause severe evaporation losses, hence leaving behind large amounts of salts. However, the problem exits even in some of the world's sub-humid and humid regions especially in coastal areas.

The term salinity refers to the presence of the major dissolved inorganic solutes (essentially Na^+, Mg^{++}, Ca^{++}, K^+, Cl^-, SO_4^-, HCO_3^-, NO_3, and CO_3^-) in water and soil (Bernstein, 1975; Tanji, 1990). The relationships of these salts to each other as well as to other ions are important and may differ greatly at different sites. Soils containing high salts occur naturally in arid and semiarid climates, however, salinity problems occur when salt accumulates in the crop root zone up to a concentration that causes a loss in yield (Francois and Mass. 1999). Crop plants that grow in saline soils are affected by the high level of solutes, which result in yield losses (Mbarki et al., 2018). When the soils have problem of excessive soil moisture in addition to high level of soluble salts in the root zone, plant growth is either limited or totally prevented (Gupta and Abrol, 1990). In general, the fine roots of plant take up water by the process of osmosis, which involves the movement of water from states of low salt concentration to states of high salt concentration. However, when salt concentration in the soil and water is high, the movement of water from the soil to the root delays and water use efficiency declines (Yuan, 2018). When the salt concentrations in the soil are higher than inside the root cells, the soil will pull the water from the root (Munns, 2005).

Soil electrical conductivity (EC) is an important indicator of soil health as it measures the amount of salts in soil. Saline soils are those have an electrical conductivity of the saturation soil extract of more than 4 dS/m at 25°C (Rusydi, 2018). When soil has less than 1dS/m of EC, soil is considered non-saline and it does not influence crops and soil microbial processes, but when soil electrical conductivity is greater than 1dS/m soil is considered saline and it negatively affects plant growth and development. It also largely affects microbial processes, such as nitrogen cycling, production of nitrous and other N oxide gases, respiration, and decomposition; populations of plant-parasitic nematodes can increase; and increased nitrogen losses (Grisso et al., 2009).

Salinity is one of the major abiotic stresses affecting germination, and crop growth and productivity. Soil salinity affects crop yields, crop suitability, plant nutrient availability, plant nutrient uptake, and soil microorganisms activity (Munns and Gilliham, 2015; Yuan, 2018). Salinity affects crop plants by osmotic stress

(Rengasamy, 2006), decreasing water availability; (FAO and ITPS, 2015) ionic stress; and changes in the cellular ionic balance, which are in turn leading to deficiency and/or toxicity of some nutrients (Qadir et al., 2008;Singh et al., 2015; Hazman et al., 2016). Excessive salts damage plants by disrupting the uptake of water by plant roots and by interfere with the uptake of competitive nutrients. Many factors influence nutrient availability and uptake by plants in saline environments. This review is to determine soil and plant factors that impact nutrient availability and uptake in saline environments.

Factors Influencing Nutrient Availability and Uptake in Saline Environments

The availability and uptake of nutrients by plants in saline environs are affected by many factors in the soil-plant environment some of which influence the rates of nutrient uptake by roots.

Soil Factors

Soil factors such as soil structure, water availability, soil minerals and fertilizers, and soil pH can affect rates of nutrient uptake.

Soil Texture and Structure

Soil texture is the amount of sand, silt, clay and organic matter in the soil. Soil texture affects soil's capability to hold water and nutrients. Silt and clay soils have a larger surface area than sandy soil, and a large surface area allows a soil to hold more water and nutrients. In general, soils that have high percentage of clay, silt, and organic matter tend to hold water and nutrients more efficiently than sandy soils (Kowaljow et al., 2017). Clay soils can attribute to salts and tend to be more saline whereas sandy soils are less saline because salts do not attribute to sand particles and it leaches easily. Soil structure is the arrangement of soil particles into aggregates. It influences water availability, nutrient uptake and recycling, root depth, and leaching. Good soil structure and high aggregate stability are essential to increase soil fertility, increase agronomic productivity, decrease soil degradation, and enhance porosity (Lai, 2015). Na^+ is a highly distributing agent and high concentration of Na^+ leads to break down soil aggregations, which may make soil organic matter more available for decomposition (Lai, 2015). Some management practices such as the use of salt-tolerant plants is a key to reduce the effects of high Na^+ concentration. In addition, Gypsum application is highly effective as a treatment for reducing amounts of exchangeable sodium and inhibiting clay dispersion in saline soils (Armstrong and Tanton, 1992). A recent study found that salt stress had significantly reduced plant biomass in sandy soils compared to those in clay soils (Mbarki et al., 2018). This could be due to its higher clay content, which influenced water quality in clay soil compared to sandy soil (Taghizadehghasab et al., 2021).

Water Availability

Naturally founded salty soil is a major resource of salinity. Salty soils are mostly found where rainfall is low and in coastal regions where salty water has entered the soil or salt spray has been absorbed by plants and soil (Tanji, 1990). However, when the soilhas problem of extreme soil moisture in addition to high level of soluble salts in the root zone, plant growth is either limited or entirely prohibited (Gupta and Abrol, 1990). Real plant performance during growing is related to how these plants respond to both salinity and water stress. The primary effect of soil salinity is reducing the water available to plants even though water is still present in the root zone. Salinity reduces the ability of plants to take up water (Munns, 2002). For saline water having low osmotic potential results in decreasing availability of water to root cells, which in turn exposes the plant to secondary osmotic stress. This implies that all the physiological responses, which are related to water deficit stress, can also be observed in salinity stress (Qadir et al., 2008). Once there is sufficient moisture leaching in the soil, water can take away dissolved salts from the root zone. In many saline soils, water tables close to the surface can greatly modify the nutritional needs. The other osmotic effects of salts in the soil solution namely extreme concentration and absorption of specific ions may produce toxicity to the plants. It is well known that high concentration of neutral soluble salts in soils compete with the normal nutrition of crops in saline soils (Mass and Grattan, 1999; Oster et al., 1999). In saline soils, the uptake of sodium and chloride ions increases severely, which results in reducing uptake essential plant nutrients such as Ca^{+2}. Accordingly, even if the Ca^{+2} is present in the soil in a good status, Ca^{+2} is not available for plant up take i.e. the plant cannot take up that nutrient because of excess uptake of Na^+ ions (Mass and Grattan, 1999). Numerous studies found that deficiencies of some nutrients such as K and Ca seem to play an important role in the growth and yield reduction in crops that grow in saline soils (Mass and Grattan, 1999).

Soil PH

Soil pH is one of the most important soil properties that affect nutrients' availability and uptake. Soil pH defines the relative acidity or alkalinity of the soil. Most plants grow better in a pH range of 5.5 to 7.5. In this pH range, essential nutrients are available in chemical forms that plant roots can absorb. Soil pH is an important parameter since pH affects the solubility and ionic form of particular nutrients. Certain mixtures of total salt concentration, Na and pH can badly affect soil properties for irrigation and cropping. The pH of saline soils is mostly below 8.5. High concentrations of Na^+ and Cl^- in the soil solution will reduce nutrient-ion activities and create extreme ratios of Na^+ /Ca^{++}, Na^+/ K^+, Ca^{++} / Mg^{++}, and Cl^- / NO_3, which in turn result in osmotic and specific ion injury (Alam, 1999). Also, high pH soils with high salt concentration greatly changes the nutrients available to the plants because high pH levels change the ionic form of some plant nutrients to the extent that makes nutrient unavailable to plants up take. In regions with low rainfall, high saline soils are more common because there is less precipitation to leach the alkaline metals, which increases soil ph. In such soils, high pH can be coupled with high levels of carbonate, bicarbonate, and sodium, which can reduce water infiltration and drainage rates by blocking pores with dispersed soil particles (Provin and Pitt. 2001).

Soil Minerals and Fertilizers

Salinity may cause nutrient deficit or imbalance because of competition of Na+ and Cl^- with nutrients such as K^+, Ca^{++}, and NO_3^- (Nour, 2017). A study by Ruiz et al., 1997 found that the salinity altered mineral nutrient distribution and decreased absorption, and specific utilization rates of some nutrients. In fact, the interaction between fertilizers supply and salt stress response diffed and depended on the mineral elements (Hu and Schmidhalter, 2005). Under saline conditions, Na^+ and/or Cl^-, most of the time go above macronutrient concentrations therefore high concentrations of Na^+ and Cl^- in the soil solution may lower nutrient-ion activities and result in extreme ratios of Na^+/ Ca^{++}, Na^+, /K^+, Ca^{++}/Mg^{++}., and Cl^- /NO^-_3. Consequently, the plant is subjected to osmotic and specific ion injury as well as to nutritional disorders that may reduce yield or quality (Mass and Grattan, 1999; Oster et al., 1999). Salinity may cause nutrient deficiencies or imbalances due to the competition of Na^+ and Cl^- with nutrients such as K^+, $Ca2^+$, and NO^-_3 (Hu and Schmidhalter, 2005; García-Caparrós and Teresa, 2018). Another study found that absorption of N, P, K Ca, and Mg decreased with salinity increase (Loupassaki et al., 2002). It’s a fact that plant growth increases by nutrient application regardless of whether the plants are grown in saline environments or not. However, the nutrient concentration is the limiting factor in non-salinity conditions, but in saline environment, salinity will be the limiting factor for plant growth (Maas, and Grattan, 1999). A study concludes that when the drought or salt stress is severe, an increased nutrient supply will not improve plant growth when the nutrient is already present in sufficient amounts in the soil (Hu and Schmidhalter, .2005). Many studies found that fertilizers may either increase or decrease crop salt-tolerance depending on salinity level and the degree by which the nutrient in the system is limiting Figures (1), (2). Mass and Grattan, 1999 found that when crops are grown on low fertility environment, they seem to be more salt tolerant than crops grown with sufficient fertility (Maas, and Grattan, 1999). A soil’s cation exchange capacity must be considered when determining the proper rates and timing of fertilizers applications. In fact, soil with low cation exchange capacity, such as sandy soil, a smaller amount of fertilizer is recommended to prevent leaching losses, however, soils with high cation exchange capacity, such as clay soils, more amounts are recommended.

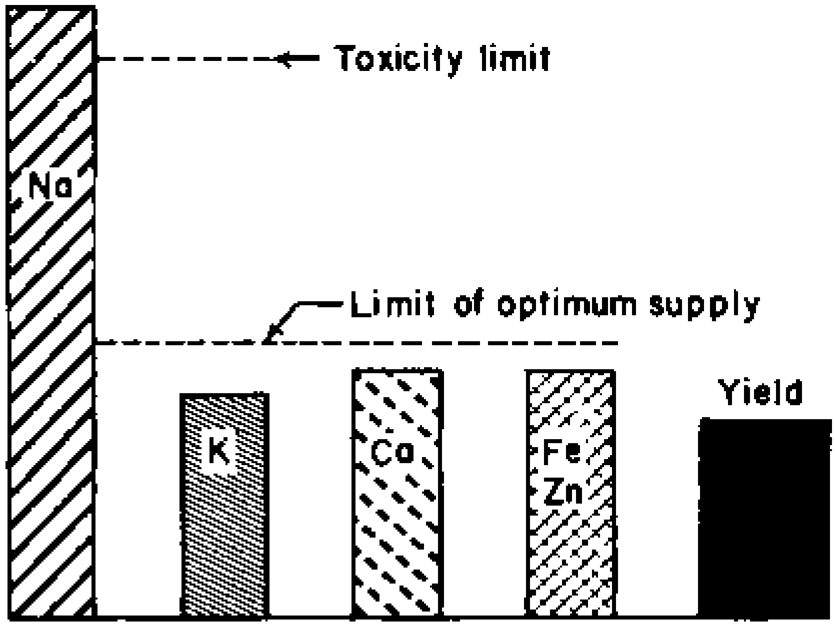

Figure (1): Schematic Diagram Showing the Effect of Fertilization for Correction of an Unbalanced and Insufficient Nutrient Supply to Plants in Saline Soils; the Columns Indicate the Plant Contents (Nutrient Supply without Fertilization) (Abrol et al. 1988).

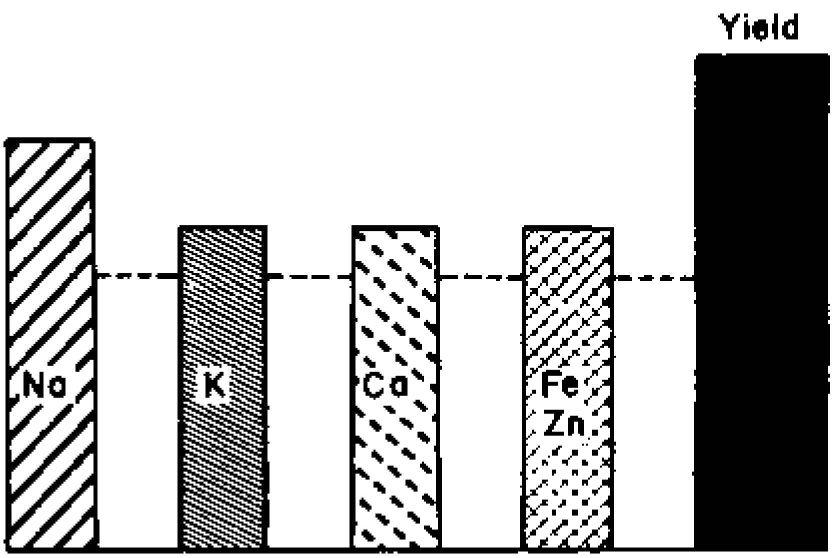

Figure (2): Schematic Diagram Showing the Effect of Fertilization for Correction of an Unbalanced and Insufficient Nutrient Supply to Plants in Saline Soils; the Columns Indicate the Plant Contents (Nutrient Supply with Fertilization) (Abrol et al. 1988).

Nitrogen

Nitrogen is of the most important elements for plant growth and development and plants require nitrogen in high amount. Mobility of a nutrient inside the soil is highly related to the chemical properties of the soil such as cation exchange capacity, and soil moisture. When there is sufficient moisture in the soil leaching can happen and water can take away dissolved salts, which will be later lost from the soil profile. However, crops in saline soils are subject to water stress therefore adding N fertilizer may not improve plant growth and yield without adequate water being available to the plants (Hu and Schmidhalter, 2005). Also, total shoot Nitrogen uptake decreases under saline conditions, but the N concentration increases or remains unchanged when Nitrogen is applied in adequate amount (Hu and Schmidhalter, 1998). In addition, some findings showed that especially in some woody plants like vines and trees the addition of Nitrogen fertilizers as NO_3 reduces Cl- uptake and accumulation because of NO_3 /Cl^- competition (Maas, and Grattan, 1999; Bernstein et al., 1974). Moreover, high salinity could inhibit the growth and activity of the soil's microbial population,which affects the conversion of essential plant nutrients and their availability to plants. Other influences, which are expected to influence the N^- fertilization of crops grown in saline soils, are high leaching and losses of N as NO_3, andnitrification rates decrease because of high salt concentration, and the toxic effect of ions such as chloride on the microbial activity (Feigin, 1985).

Phosphorus

Phosphorus (P) is the second essential nutrient required by plants for normal growth and development. Soils in arid areas are often calcareous and subject to high pH. This causes a reduction on the availability of P to plants uptake in saline soils as P becomes insoluble due to the formation of soluble calcium phosphate minerals. The bioavailability of P is strongly tight to soil's pH; the maximum solubility and plant availability of P is at pH 6.5. In general, the uptake of P by crop plants is reduced in drysoil conditions (Pinkerton and Simpson, 1986). Many studies have found that P uptake by plant is reduced due to the presence of Cl^- and SO_{42}^- Figure (3) Zhukovskaya, 1973). Another reason of the reduced availability of P in saline environment is due to ionic direct effects that reduce the activity of P and because P concentration in the soil solution is in low solubility (Maas, and Grattan, 1999). Some results showed that quite high and repeated P fertilizer rates are necessary for crops grown in saline soil (Hu and Schmidhalter, 1998). Also, P availability to plants for uptake can be achieved by any processes that result in an increase in P solubility. One way to reduce the negative impact of salinity on P availability to the plant is by improving the microbial activity, especially Fungi, in that soil (Richardson and Simpson, 2011; Kumar et al., 2018). It is a fact that microorganisms differ in their ability to survive with the adverse effects of high salt levels. For example, mycorrhizae fungi are very important, and much work has been done in this area. Some studies showed that mycorrhizae fungi have the ability to improve plant growth and development. Mycorrhiza has improved plant P uptake (Bhantana et al., 2021). To some extent, this effect is true under saline soils. A recent investigation showed that mycorrhizae fungi may alleviate salt stress of plant Bothe (Sagar et al., 2021).

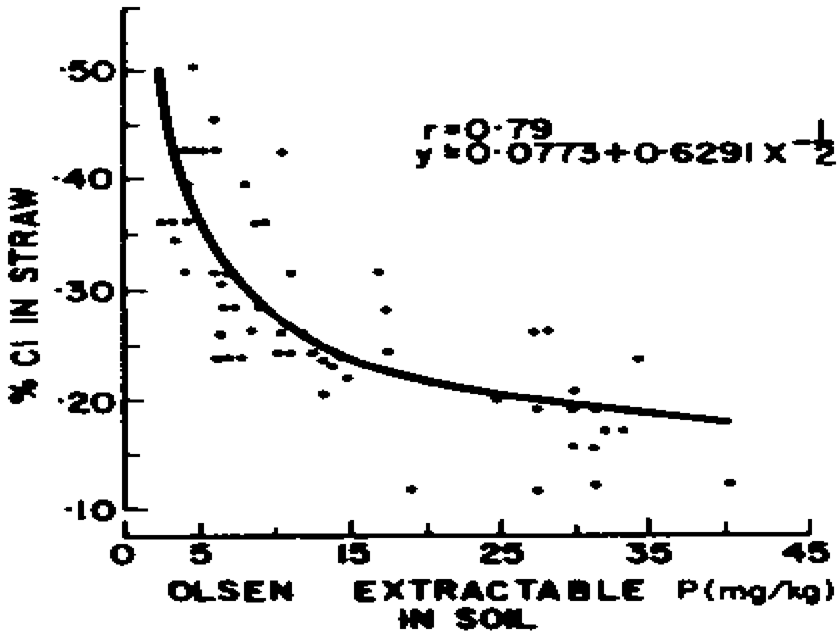

Figure (3): Effect of Available Soil Phosphorus on the Chloride Content of Wheat Straw (Abrol et al. 1988).

Potassium

Potassium is the one of the macronutrients that plants require in high amounts. Potassium is an important factor in protein synthesis, glycolytic enzymes, transport of water and nutrients throughout the plant in the xylem, stomatal activity and photosynthesis (Hu and Schmidhalter, 1998). Potassium also plays a main role in the regulation of water in plants. The uptake of water through plant roots and the loss of water vapor through the stomata are regulated by potassium. Potassium uptake by plants can be affected by high salinity and Na concentration in the soil solution. Under saline environment, high Na^+ concentrations in the soil solution result in decreased K^+ concentrations in some of plant species because of the competition of Na^+ and K^+ at uptake sites in the roots (Hu and Schmidhalter, 1998). The main chemical reactions that control potassium transport and its availability to crops are the exchange with other cations and fixation by clay minerals and soils particles (Kumari et al., 2021). Many studies showed that Na and the Na/Ca ratio affect K uptake and accumulation within plant cells, and reported that salt tolerance correlates with selectivity for K^+ uptake over Na^+ (Wrona and Epstein, 1985). Some researchers examined the effect of K fertilization under saline conditions; they found that there is small reduction in salinity damage to several crops when high concentrations of K are applied to those crops (Machadom and Serralheiro, 2017). However, other studies showed opposite results and found either no response to K under salinity or an adverse effect of K nutrition on salt tolerance. (Lauter, 1988). Therefore, in saline soils managing K application is very important. Some studies suggest that supplementary P and K can reduce the adverse effects of high salinity on plant growth and physiological development. Supplementary potassium sulphate can partially ameliorate the negative effects of high NaCl concentrations. (Kaya, 2001).

Plant Factors

Plant factors such as plant genotype, rooting patterns, stage of growth and crop performance, and plant physiology can all decrease rates of nutrient uptake by plant roots.

Plant Genotype

Salinity levels in soil and/or irrigation water have variable effects on different plant species. Plant species and genotypes within species show differential responses to salinity stress (Ehtaiwesh and Rasked, 2020). Some important fibers and grain crops such as barley, rice, wheat, sorghum, and cotton can be grown in saline soils and may be irrigated with low to moderate saline water (Hussain et al., 2019). However, plants respond differently to high salt concentrations. Some crops, like beans and strawberry are highly sensitive even to moderate salt concentrations (Ehtaiwesh and Abuiflayjah, 2020; Malekzadeh Shamsabad et al., 2022). For example, beans show symptom of wilting when the plants are exposed to high concentration of NaCl because of the effect of Na^+ on the ability of the plants to take up water. Also, plant roots lose water by osmosis, because of the high level of salts around the root. On the other hands, some crops such as barley, cotton, and sugar beet are slat tolerant and they grow well in moderately saline environments (Maas, and Grattan, 1999). One of the most likely fruit trees in saline environments is olive, which is a glycophytic species that avoids salinity stress by salt exclusion (Gucci and Tattini, 1997). Nonetheless, some plants are very sensitive to the Cl^-. For example, many woody species are subjected to CI^- toxicity, which varies among varieties and rootstocks within species (Mss et al., 1983; Hussain et al., 2019). A study conducted on two citrus species (Star Ruby' grapefruit and 'Clemenules' mandarin trees) indicated different physiological and agronomic responses for salinity tolerance (Pérez-Pérez et al.., 2015). The ability of plant species to tolerate salinity is described in relative terms and generally divided into four categories sensitive, moderately sensitive, moderately tolerant, and tolerant (Francois and Mass. 1999; Mansour et al., 2020). Plant species and genotypes within species show different responses to salinity stress (Maas and Hoffman, 1977). A study by Maas and Hoffman on date palm found that palm trees have the highest salinity tolerance among fruit trees (Maas and Hoffman, 1977). A new study on different Iranian wheat genotypes reported that those wheat genotypes responded differently to salinity. Namvar et al., (2018) concluded that

Chamran, Azar-2, Sardari and Atila-4 were more resistant to salinity stress compared with other genotypes studied.

Stage of Growth and Crop Performance

Crops have different sensitivity to soil salinity at different growth stages. Many studies showed that plants are tolerant during germination stage and become more sensitive to salinity during the seedling stage (Mass et al., 1983; Giuffrida et al., 2016; Hussain et al., 2019; Ehtaiwesh and Emsahel, 2020). Most plants become more tolerant during later stages of growth and development (Maas and Hoffman, 1977). For example; the physiological responses of cereals to salt stress differ at different stages of growth and development and depend on the time of exposure and the severity of the stress (Munns and Tester, 2008). Moreover, the nature of the salts present in the soil may affect the response of plants to salt stress. However, continued growth of cereal plants under saline conditions is dependent on their ability to control the influx of salts to their shoot through the transpiration stream (Greenway and Munns, 1980). Many studies point out that crops are more sensitive to salinity during the seedling stage than during germination, and this depends on the crop (Maas, and Grattan, 1999). Seedlings also are more sensitive than grownup plants (Sharif et al., 2019). A study by Maas and his team on corn and wheat reported that the dry matter yields of these plants are reduced as the concentrations of salt increased (Mass et al., 1983). Some work done to investigate the relationship between several yield components and increased salinity at different growth stages showed that there is a linear decrease in yield components as the level of salinity increased. However, these findings recommended that seedling emergence and early seedling growth stages are most sensitive to salinity (Rashed and Ehtaiwesh, 2019; Ehtaiwesh and Rasjed, 2019).

Plant Physiology

Salinity has a negative impact on many processes, but the most important impacts are reduced cell growth and decreased leaf area, root biomass, root structure and morphology, plant biomass and yield (Acevedo et al., 2002; Giuffrida et al.., 2013). Salinity stress may limit or encourage nutrient uptake by plant species through affecting the mobility of a nutrient within the plant parts or by increasing the nutrient requirement by plants in the cells (Alam, 1999). Salt stress reduced net CO_2 assimilation, and water use efficiency (Woodrow et al., 2016; Dourado et al., 2022; Al Hinai et al., 2022). However, salt stress does not affect CO_2 concentrations in the mesophyll cells but the elevated CO_2 increased the sensitivity of photosynthesis system II and chlorophyll concentration to salinity (Melgarett al., 2008). Regarding the salinity and elevated CO_2 effect, a study by Melgar et al., found that the salt sensitive cultivar response depends on the level of salinity. They see that under non-saline condition, salt sensitive cultivar has significantly greater shoot growth, and high net CO_2 assimilation under elevated CO_2 than at ambient CO_2, but under salt stress, the response was different. However, this was not the same with salt tolerant cultivar trees. Regardless of salinity level, salt tolerant cultivar trees did not respond in terms of growth and net CO_2 assimilation to elevated CO_2 (Melgar ett al., 2008). Many papers in the literature discussed how elevated CO_2 reduces the impact of salinity on plant growth and development. Some studies found that elevated CO_2 might enhance the growth and performance of some plants grown under salinity condition (Yi et al., 2018; Zhang et al., 2020). They thought that salt tolerance would be enhanced in the plants grown at elevated CO_2. Poorter and Perez-Soba found that biomass enhancement ratio increased under high salinity in elevated CO_2 concentration (Poorter and Pérez-Soba, 2001). Another study found that CO_2 concentration notably enhances photosynthesis and water use efficiency of the halophytic plants (Geissler, 2009). Other studies reported that elevated CO_2 concentration stimulates plant growth under saline condition by enhancement of leaf water status rather than increasing in photosynthesis (Mateos et al., 2010). In addition, salinity effect plant hormones a study by Mohammad khani et al found that growth parameters reduced under salinity, and that decrease in sensitive genotypes was higher than tolerant ones. The study concluded that abscisic acid receptor increased in leaves of sensitive and decreased in tolerant genotypes. In addition, gibberellin receptor and auxin-induced protein were upregulated in roots of tolerant and down regulated in sensitive genotypes (Mohammad khani et al., 2018). Furthermore, Acetyl Salicylic (Aspirin) which considered as a hormone-like substance was used in priming of wheat seeds and found that it can be used as an effective method to improve seeds germination and seedling performance under salt stress (Ehtaiwesh and Almajdob, 2021). Another study found that Acetyl Salicylic (Aspirin) alleviated the injuries caused by salinity stress to growth and yield of faba bean plants (Ehtaiwesh, 2022).

Rooting Patterns

Salt tolerance in plants is, in some extent, depends on the ability and efficiency of root system (Alam 1999). Roots play a impotent role in improving crop salt tolerance through their potential for improving access to water and limiting salt acquisition (Jung, and McCouch, 2013). One function of plant roots, especially in drying soil, is sensors of water stress. The performance of many crops depends upon the ability of their root systems to obtain resources. The root surface area depends on root hair growth and root thickness. The ability to regulate root surface area is very important feature of plant performance and its plasticity to diversity of abiotic conditions (Smith and De Smet, 2012). In fact, in saline soils, roots act as highly effective filters and about 95% of soil salt can be excluded by the root (Hussain et al., 2021). This degree of exclusion occurs in most halophytes, and in highly salt tolerant crop species. In some of salt-tolerant species roots maintain K^+ uptake despite competitive inhibition by Na^+ due to selectivity of K^+ uptake over Na^+. However, salt contamination of soils can exploit and damage plant roots depending upon species sensitivity, environmental variables (Bernstein and Kafkafi, 2002). Additionally, the effect of salinity on root growth and soil penetration is highly depends on plant species, condition of the soil, and the level of salinity (Vaishnav et al., 2020).

Conclusions

Salinity is one of the major abiotic stresses affecting plant growth and development. It is a big issue in arid and semi-arid regions, this because in arid and semi-arid regions, high temperatures during the summer season cause severe evaporation losses, hence leaving behind large amounts of salts. However, even in some of the world's sub-humid and humid regions the problem exits especially in coastal areas and where irrigation is the main supply for water. Plants that grow in saline soils are affected by high level of solutes, which result in yield losses. Salinity affect nutrient availably and uptake by plant. Several soil and plant factors influence availability and nutrient uptake by roots in saline soils. Some of soil factors include soil texture; water availably soil pH, and soil menials. In addition to soil factor, plant factors also influence the availability and uptake of nutrients. These factors include, plant genotype, growth of plant stage, plant root system. I conclude that, both soil and plant factor contribute in nutrient availability and up take by plants in saline environment.

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