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REVIEW ON EFFECTS OF SALINITY ON PLANT GROWTH

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Abstract:
"Salinization" is one of the most important and troublesome environmental problems in agriculture. This refers to the process of making saltier. This is readily seen in water and soil reservoirs. Crop plants are not suited to provide the anticipated yield when salt is added. The plant is stunted and has a low yield as a result of this stress. This unfavorable environment alters a plant's physiology, which frequently has detrimental effects on the plant's growth and development. Numerous elements of plant growth, including as seed germination, morphological characteristics, growth, and yield, are adversely affected by salt content. Furthermore, the amount of protein, carbohydrates, and chlorophyll in a plant is impacted by its salinity levels. The total amount of carbohydrates and protein are negatively impacted by the salt effect. Salt exposure reduces the amount of photosynthesis that occurs in plants. Salinization causes osmotic and ionic alterations that result in decreased biomass production throughout the plant, even in the cells. Plant physiochemical alterations can occasionally aid in the development of a plant's stress tolerance. This essay provides an outline of the effects of salinity on plant growth as well as the changes or adjustments that plants go through when they are exposed to salt stress.

Key words: plant, salinity, seed germination, plant physiology, biochemical parameters

1. INTRODUCTION

A stress state brought on by a high salt concentration sufficient to lower the water potential is known as salt stress. According to Munns (2005) and Jamil et al. (2011), salinous soils have an electrical conductivity of 4dS/m or more and an adjustable sodium content of 15% inside the root zone. Salinity is one of the most important environmental factors impacting plant productivity, especially in dry and semi-arid regions. The effects of salinity are most apparent in semi-arid and dry areas, where high transpiration, low rainfall, high temperatures, and insufficient water and soil management practices are major contributors to saline buildup (Azevedo Neto et al., 2006). Over the past 20 years, as the need for irrigation has grown in arid and semi-arid regions like the Mediterranean, A stress state brought on by a high salt concentration sufficient to lower the water potential is known as salt stress. Abiotic stress is a major issue for agriculture worldwide as a result of rising soil and irrigation water salt levels. Soil salinity affects over 800 million hectares of arable land globally (Acosta-Motos et al., 2017), posing a serious threat to agricultural output. Naturally occurring capillary water levels rising and then evaporating saline groundwater is what causes salinization. The salinization process can also be influenced by human activity. The toxicity of salinity varies depending on the environment, including the type of plants, sunshine intensity, and atmospheric conditions. A plant's glycophytic or halophytic state dictates whether or not it can thrive in salinity. Most crop plants that are glycophytes cannot survive in high salt settings, also referred to as hypersaline environments. NaCl concentrations of 100 to 200 mM can impede the growth of these plants, ultimately resulting in their mortality

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(Munns and Termaat, 1986). However, because they have developed more robust salt resistance mechanisms, halophytes may be able to live in the presence of high NaCl concentrations (300–500 mM) (Parida and Das, 2005; Flowers and Colmer, 2015). High salt concentrations also raise the pH of the soil, which is bad for plants. For most plants, an environment with a high pH is not ideal. In addition to deteriorating soil structure, salt stress also affects the ideal air-water balance needed for biological processes at plant roots. Due to all of salinization's detrimental impacts, crop yields are dropping, and arable land is permanently disappearing (Supper, 2003). However, it has been demonstrated that higher plants can withstand excessive salinity by adding or excluding salt (Sykes, 1992). Salt accumulators breakdown salt in one of two methods, whereas salt excluders help keep excessive salt concentrations under control by keeping salt out of particular organs or the entire plant. The first technique involves the removal of excessive salt into the roots, where the roots may absorb salt ions without being injured, and the second involves the cell membranes of resistant plants being able to withstand high concentrations of internal salt.

1.1 Impact of salt stress on plants

Salinity causes disruptions to several plant physiological systems, such as: 1. Osmoregulation; 2. Photosynthesis; 3. Aerial development is inhibited by a long-range signal; and 4. Inadequate mineral supply. (2017) Negrao et al.Excessive salinity stunts the growth of roots due to the impact of osmotic and toxic substances on roots (Banon et al., 2012).

1.1.1 Salinity and seed germination

In halophytes, salinity normally has an osmotic effect; in non-halophytes, however, it can be due to excess ion toxicity. (Bajji and others, 2002). Halophytes, as opposed to non-halophytes, can tolerate high salinity levels without losing their seed viability, and they will eventually germinate when the salinity stress is alleviated (Keiffer and Ungar, 1997). Changes in the content of NaCl have an impact on Tephrosia purpurea seed germination rates. It was discovered that during the germination stage, seeds were susceptible to high salinity levels, and that germination was enhanced by a 50 mM NaCl concentration when compared to the control. High salt concentrations can affect seed germination, causing a reduction in seed germination (Sunita K. et al., 2013). 50 to 400 mM NaCl consistently slowed down wheat germination; however, no effect was seen at 20 to 40 mM NaCl. When kinetin and GA are combined with NaCl salinity, the result is an increase in wheat germination (Begum F. et al., 1992). Magnesium chloride, calcium chloride, mannitol, and sodium chloride were all found to be germination-inhibiting agents in alkali sacaton (Sporobolus airoides Torr.), and this reliance is more than that of total salt (Hyder and Yasmin, 1972). Salinity affects plant growth differently depending on the genotype and species of the plant. Therefore, to increase salt tolerance, it's imperative to monitor the genetic variety across genotypes of plant species (Ashraf et al., 2006; Ranjbar et al., 2012). Moreover, it has been demonstrated that salt stress increases the germination time and decreases the proportion of sweet sorghum that germinates (Almodares et al., 2006). Because of the decreased osmotic potential of seed media, which restricts water absorption and thus lowers germination, salt essentially has the power to effect germination via changing water absorption from seed (Khan et al., 2006; BAE et al., 2006). Furthermore, because of salinity, the cytotoxic effect of

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ions may change the activity of enzymes. This disturbance of enzyme activity during plant germination may lead to aberrant metabolism of proteins and nucleic acids, as well as an imbalance in hormones. Furthermore, salinity is thought to interfere with the metabolic process of seed germination, which reduces the amount of seeds used. The increase in phenolic content has the effect of interfering with the metabolic process.

1.1.2 Salinity and Plant Physiology

Salinity has a variety of effects on plant physiology, such as increased respiration, ion toxicity, altered plant development, altered mineral distribution, membrane instability, and a decrease in photosynthetic activity (Marschner, 1986). (Munns, 2002; Sayed, 2003). The plant experiences major changes from the moment it is a newly formed baby plant until it reaches adulthood. A plant cell exposed to salt stress collapses and becomes dehydrated immediately, yet it recovers in a few hours. Despite this development, mitosis and cell expansion are impeded, which slows the growth of roots and leaves. Lateral branch development is disrupted within a week of the onset of salt stress, and within a month, the overall development and damage of salt-stressed plants and their non-stressed counterparts clearly vary. Plants' ability to absorb is diminished by the osmotic effect (Munns, 2005).

Chlorophyll Content

The physiological parameters that govern leaf photosynthetic potential are chlorophyll concentration, Rubisco action, and photosystem performance (Flore and Lasko, 1989; Bowes, 1991). Agave americana (Sileret al., 2007) and Satureja hortensis (Najafi et al., 2010) exhibit decreased concentrations of chlorophyll a and b, as well as total chlorophyll, in response to increasing salt. It's possible that both decreased synthesis and greater breakdown of photosynthetic pigments contributed to the decrease in pigments seen in plants cultivated in saline environments (Garsia- Sanchez et al., 2002).

Carbohydrates

The saline action decreased the amount of carbohydrates in fennel overall (Abd ElWahab, 2006). However, as demonstrated by the Satureja hortensis, plants treated with NaCl have a higher content of soluble carbohydrates (Najafi et al., 2010).

Lipids

According to Malkit et al. (2002), salt stress modifies the profile of fatty acids and impacts plant oil yield and fatty acid biosynthesis. It is thought to be crucial for a plant's ability to withstand salt. Additionally, it was discovered that salt dramatically reduced the overall fatty acid content of Coriandrum sativum leaves, and that as NaCl levels increased, so did the fraction of -linolenic and lenoleic acids.

Proteins

According to reports, both the protein content and the concentrations of NaCl in Catharanthus roseus have drastically decreased (Osman et al., 2007). Salinity reduced the amount of soluble proteins in sweet marjoram and chamomile (Ali R et al., 2007). Under salt stress, proteins in plants may cluster and store nitrogen for later use, or they may be involved in osmotic regulation (Singh et al., 1987).

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Plant Hormones

Among the hormones that plants produce are auxins, gibberellins, cytokinins, abscisic acid, and ethylene (Mehmood et al., 2018). High salt content raises levels of phytohormones like ABA. Salt-induced genes, which are thought to be important in the salt tolerance pathway, are altered by abscisic acid. Abscisic acid has been reported to reduce the accumulation of harmful Cl-ions in the leaves, which in turn reduces ethylene generation and leaf defoliation during salt stress. Another plant hormone that builds up in the presence of salt is jasmonates, which has been proposed to be important for salt tolerance (Omant et al., 2006). The detrimental effects of salinity on crop morphological (leaf area, dry weight), physiological (net photosynthesis, stomatal closure, photosynthetic rate), and yield variables have been reported to be lessened by extracellular plant hormone treatment administered to salt-stressed plants. (Seeta Ram Rao and Anuradha, 2001; Khan et al., 2019).

Conclusion

Salinization alters osmotic and ionic conditions in a way that impacts the physiology of the entire plant as well as the cellular level, which lowers biomass production. Almost all stages of plant growth, including seedling, vegetative, and maturity phases, are negatively impacted by salt stress. Numerous scientific investigations carried out by various scientists have demonstrated that exposure to salt damages plant growth, leading to considerable losses in crop yield. Plant biochemical characteristics, including carbohydrates, proteins, lipids, and hormones, are contingent upon the species of the plant and the salinity concentration. Most plants experience a decrease in net photosynthesis and chlorophyll when salinity levels rise. Plant breeders and physicists have successfully developed salt-tolerant varieties through a range of breeding techniques, including molecular genetics and biotechnology; however, in order to develop varieties that are resistant to multiple stresses while maintaining soil quality, it is still necessary to use multiple mechanisms and integrate the traits of ideal plant types.

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