Journal of Advances and Scholarly Researches in Allied Education
Vol. 12, Issue No. 2, January-2017, ISSN 2230-7540

Salt Stress Effects on the Plants: A Review

Ranju Gulati*

Department of Botany, DAV College, Chandigarh

Abstract – Salt stress is one of the greatest abiotic threats to plant life worldwide and reduces crop yields significantly in the areas affected. Past what plants need, unnecessary salt cutoff points plant growth and efficiency and can prompt plant demise. Soil salinity influences around 20% of all inundated land, diminishing harvest yields. Plants are influenced in two principle ways by salt stress: osmotic stress and ionic harmfulness. All significant plant measures, including photosynthesis, cell digestion and plant sustenance, are impacted by these stresses. This paper analyzes the manners by which salt restrains the capacity of plants and the plants' corresponded reactions to salt stress.

Keywords- Salt Stress, Plant Growth, Salinity, Osmotic Pressure, Environment.

- X -

INTRODUCTION

Salt stress is one of the most harmful environmental stresses that simultaneously cause ionic harmfulness and osmotic stress. The number of adaptive mechanisms associated with salt tolerance or adjustment of salt stress in glycophytes, most of them associated with ion transport. The fundamental components associated with salt stress resistance incorporate K+ maintenance and Na+ avoidance MIFE technique contributes to the realisation of the influx of these major ions across membranes, providing breeders with insight into developing more salt-tolerant species of plants. Different scientists have utilized MIFE strategy to research hindering impacts of different abiotic stresses, including salt, water logging and oxidative stresses and salt resilience frameworks. In a study of the ionic and osmotic stresses of salt stress Shabala and Newman (1997) employees used MIFE technique to study the K+ flux and differ. Cytosólic K+ has recently become the main component of the plant salt tolerance mechanism in leaf mesophyll retention capacity. Wu et al. (2015) used the MIFE screening technique as a tool for screening salt stress tolerance plants and have shown that MIFE is a very useful technique for the study of f plant cell-level salt stress resilience. Wang et al. have also shown that a useful approach for improving barley salt-stress tolerance could be used to examine the oxidation effects of reactive oxygen species (ROS) on K and Ca fluxes under salt stress.

Salinity is the accumulation of excess salt in the soil, which ultimately leads to crop growth inhibition and crop death. No other toxic material is as dangerous to cultivation as salt on a global scale. Salt stress is seen by reducing land productivity and reduced crop yields as an alarming condition. 20% of developed land and practically 50% of flooded land are thought to be influenced by salt stress which is not exactly hereditary potential. The increase of soil salinity is suspected of resulting from poor irrigation water quality and brackish use. High salt stress influences plants in a scope of ways, including particle harmfulness, wholesome problems, changes in metabolic cycles, oxidative stress, genotoxicity, disorder of the membrane, cell divide and expansion reduction, and water stress.

Salt stress influences plant growth and growth; however it varies with the extent of stress and the phase of cultivation. In the primary period of stress without arriving at harmful sodium, momentary openness to salt stress impacts plant growth because of osmotic stress.

EFFECTS OF SALT STRESS ON PLANT GROWTH

In comparison to the tillering phase, plants are more sensitive to salt stress in early planting. Planting growth and new weight diminished from 5 to 7.5 dS m1 with expanded salt stress. Different greenhouse studies and field studies showed that the density and production of seedling biomass decreased by salt stress. Root has direct contact with the soil environment and the rest of the plant's biotic and abiotic factors. However, water and solutes are very important in plants via the apoplastic transpiration pathway through a combined system of different pathways like symplastic, apoplastic and transcellular. Mostly Na+ transits in plant shootings along the apoplastic pathway through solvent drag and Casparian bands. The average root length, average plant root numbers and shooting length was considerably reduced when there was increased salt stress. Root and spring lengths are therefore two indicators of plant reaction to salt stress. The division of plants' cells and elongation of cells is seriously affected by salt stress, which results in reduction and growth of the Root, leaves and yield. Tetraploid plants increased root growth, proline, membrane, organelles, nuclear stability, normal cell epidermis frequency, H+ root tip efflux, and decreased root Na + in Malondialdehyde (MDA) content compared to diploid plants. The reason for this phenomenon is exposure to the protective gap in tetraploid plants between cortex and pericycle cells, which increases the resistance of the root to salt stress, improves the transport to root roots of H+ and helps to reduce Na+ input into the root of plants. The mortality of plant leafs increased in all plant cultivars in early planting stage with increased salt stress. The mortality of the leaf in salt stress is about 0 to 300 per cent following 1 wk. Salt stress shows decreased growth and growth later in a few months. The leaf deaths and declines in the leaf region may result and the plant photosynthesis rate may ultimately be reduced. Salt stress has particular effects on the metabolism of plant cells, especially on leaf senescence. It can also damage cells in sweaty leaves and cause inhibition of plant growth. The salt concentrate in the old leaves kills the leaves and this is essential if a plant is to survive.

EFFECTS ON GERMINATION AND PLANT GROWTH

The salt stress primarily affects germination of seed by lowering the soil solution's osmotic potential to delay water uptake by seed, by causing the embryo toxicity of sodium or chloride, or by altering protein synthesis. Hyper-OSS and sodium-chloride poisonousness impacts may postpone or hinder germination on developing seeds in a saline environment. In plants, nonetheless, the principle issue of the second period of salt stress is sodium poisonousness and not chloride harmfulness. and not chloride toxicity.

Salinity reduces shooting growth by suppressing initiation and expansion of leaves and by accelerating internode growth. As a salt-delicate yield, shooting growth in plants is firmly hindered in the principal period of salt stress, because of a decrease in prolonging cells and additionally the the cell augmentation. During the primary period of salt stress,, De Coste et al. (2007) noticed hindered plant growth with dull green leaves with no indications of poisonousness because of weakened growth due to the proceeded osmocosmosis and the support of turgor. The growth of salt-resistant hybrids has also shown that the growth of cell extension during the first step of salt stress has been restricted, rather than turgor, by cell wall extensibility. While the root is the main organ presented to salt stress, it is more defenseless than roots to salt stress, it is more susceptible than roots to salt stress. The Casperian strip is closer to its root tip than it does with non-saline roots. Salinitis promotes suberisation of hypodermis and endoderma. Saltiness can also remove calcium from plasma membrane-binding sites, leading to membrane leakage as the main cell reaction to salt stress. Anyway the cycle of the cell wall fermentation, which incompletely relies upon the adenosine-driven triphosphate outer siphoning of protons across the unblemished plasma membrane, can be influenced if salt stress influences the integrity of the plasma membrane.

EFFECTS ON ASSIMILATION

Excesive accumulation of sodium and chloride ions in salt soil in the rhizosphere has led to severe nutritional imbalances in plants as the main toxic ion interfered with potassium and trananasium in plants because of strong interference from those ions with other essential mineral elements, such as calcium, phosphoric, manganese nitrogen potassium, zinc , magnesium, iron and copper. Competition among sodium and potassium beneath salt stress considerably reduces the content of potassium in both leaves and plant roots. In addition, salt stress reduces not only the potassium absorption rate but, to a greater extent, disturbs the translocation of potassium from root to tissues in plants which leads to less potassium injection than the root. Reduced levels of potassium in salt leaf plants were observed, but root potassium content was not reduced in certain genotypes. The inhibition in the translocation of potassium usually is higher at low potassial concentrations under salt stress and depends on a root- and root-potassium concentration.

Increased accumulation of sodium also disrupts calcium nutrition in the first stage of salt stress; the transport of calcium into the younger plant leaves will suffer. Reduced expansion of the leaves with reduced calcium content is due to reduced transportation in a saline environment in plants expanding the shooting tissues; certain calcium is important for appropriate cell membrane respectability to work. High levels in the overall plant and apoplast, for sodium/potassium, sodium/calcium and sodium/magnesium ratios and tissue spread symplast in plants confirms that impaired transportation of potassium, calcium and magnesium by sodiums may adversely affect the metabolism of plants leading to reduced growth in saline conditions. In another study, substantial sodium levels decreased in ten plant hybrids and salinity, resulting in lower potassium/sodium and calcium/sodium ratios

EFFECTS ON GRAIN DEVELOPMENT

Panicles are a major problem for salt stress grain yield. Some cultivars suffered from panicle sterility due to certain genetic mechanisms and nutrient deficiencies due to the salinity effect, in particular during pollination and fertilisation. Different studies have found that salt stress may cause panicle sterility during fertilisation, leading to a drop in grain setting, pollen bearing ability, and a decline in stigma. Lack of transformation of carbohydrates into vegetative growth and growth of spikelets is the main cause of lower grain yield during salt stress. In many salt-stressing yield components, including the number of tiller plants, the number of spikelets per panicle and percentage of sterile blooms Zeng and Shannon (2000) have noticed negative linear relationships. Moreover, the major reasons for lower grain output under salt stress are a substantial reduction in the translocation to higher and lower spikes of soluble sugar and furthermore, restraint of starch synthetase action during grain advancement.. The effect of salt stress has serious implications for yield components, such as spikes, panicle length, number of tillers per plant, number of florets per panicle and 1 000-corn weight. Zeng and Shannon (2000) studied the connection between salt stress yield parameters. The growth of seedlings with expanded salt stress from 1,9 to 6,1 dS m1 has been altogether diminished.. A decrease in the number of panicles filled with salt stress decreased from 2-8 dS m–1 in a second study. The finishing grain yield is linked with all these yield components. This phenomenon of salt stress in terms of loss of yield must be understood.

EFFECTS ON LIGHT HARVESTING AND CARBON FIXATION

Photosynthesis is the most important process by which green plants convert sunlight into chemical energy by synthesising organic compounds with the fixing of the carbon dioxide of the atmosphere. Carbon attachment is highly susceptible to salt stress in plants. The combination of both stomach and non-stomatal constraints are associated with reductions in photosynthesis caused by salinity. The key elements limiting carbon fixation capacity of the plants at salt stress are reduced stomach conductivity, impaired carbon fixation activities, decreased photosynthesis pigments and the destruction of photosynthesis apparatuses.

The main factors responsible for photosynthesis are the decrease of total photosynthesis due to inhibited leaf development and expansion and early leaf abscissure and as salt stress prolonges, ion toxicities, membrane disturbing and complete stomach closure. The reduction in stomach openings was recognised by Munns and Tester (2008) as the most dramatic and readily measurable response to salinity by the entire plant and also found that the external osmotic effects of salt induce stomatal reactions. Salt stress immediately affects stomatal conduct because of disrupted water supply and shortly thereafter because of the local abscisic acid synthesis.

EFFECTS OF SALT STRESS ON PLANTS PHYSIOLOGICAL CHARACTERISTICS

Physiological characteristics of plants in their rhizosphere are susceptible to high salt. Salt stress showed several physiological effects on plants such as declines of pigment active (PAR), net photosynthesis (Pn), stomatal behaviour (Gs), sweating rate (Tr), pigment degradation and relative water content (RWC). Salt stress also has a major impact on plant water efficiency (WUE). The biomass and seed yield are correlated positively to WUE. WUE improved in 2 dS m–1, but WUE reduced in plants, with increasing stress on salt. These factors all have negative pleiotropic effects and annoying plant growth, development and, finally, plant deaths on plant physiologies at the molecular and biochemical levels. Effects on salt-stress plants have reduced the photosynthetic efficiency by the photosystem II complex (PSII). Moreover, the addition of Na+ and Cl– that could hinder the major electron transportation in PSII damages the content of Chlorophyll in leaves. Cha-umi et al. (2009) found a significant decrease in plant leaf chlorophyll and carotenoids content following imposition of salt stress. The quantium yield of the complex PSII was also decreased with high salt stress and the K+/Na+ ratio was also reported. Higher levels of salt-sensitive cultivars (qN), with reduced PSII quantium output (FV/Fm), and photochemical coefficient of quenching Dionisio-Sese and Tobita (2000) were seen in higher non-photochemical quenchings (qP). Therefore, for integrated partitioning of the higher and lower spikes, higher photosynthesis rate is better.

EFFECT ON MINERAL UPTAKE AND ASSIMILATION

In salted land, a solid impedance by these particles in other basic mineral components, for example, calcium, magnesium, nitrogen, potassium, phosphorus, iron, copper manganese, and and zinc, leads to severe food imbalances in the plant due to the over-accretion of sodium and chloride ions in the rhizosphere. The In general, the consumption of nitrogen, potassium, calcium, magnesium decreases with salt stress. Sodium is the main toxic ion in plants that interferes with the intake of potassium and transport leading to stomach modulation disturbances and to water loss and necrosis. The potassium/sodium competition under salt stress severely reduces the potassium content of both leaves and plant roots, reducing the amount of potassium in the symplasty of the expansion of the salt tissue by up to 64%. In addition, salt stress not merely lowers the amount of potassium intake, but also in particular disturbs the translocation of potassium from root to tissue in plants, which results in lower levels of potassium intake than root contents. Reduced levels of potassium in salt leaf plants were observed, but root potassium content was not reduced in certain genotypes. Net potassium absorption depends on the concentration of potassium in the root and root potassium, and potassium inhibition is usually higher at low potassium levels when stressed.

More sodium also interferes with calcium nutrition in the first phase of salt stress; the transportation of calcium into the smallest plant leaves is undermine. Reduced expansion of the leaf with reduced calcium content in expanding plantsis shoot tissues because of the reduced transport of plants in a saline environment. High levels in the overall plant and apoplast, for sodium/potassium, sodium/calcium and sodium/magnesium ratios and tissue spread symplast in plants confirms that impaired transportation of potassium, calcium and magnesium by sodiums may adversely affect the metabolism of plants leading to reduced growth in saline conditions. In another study, the sodium content in ten plant hybrids increased substantially, leading to a reduction of potassium/sodium and calcium/sodium ratios, with increasing salinity levels.

Nitrogen absorption and translocation are severely inhibited in addition to potassium and calcium under salt stress, which leads to reduced nitrogen content in different tissues of plants. Scald and grain nitrogen intake with a maximum reduction observed at 6 dS m−1 in irrigation water have reduced the salt levels in irrigation water substantially. Further aggravated by potassium deficiency is the negative impact of salinity on the intake of potassium, calcium and magnesium. The concentrations of potassium and magnesium were drastically decreasing both under potassium-deficient and saline conditions, but with combined stress than under individual salt or potassium stress. However, the decrease was significantly higher under combined stresses. Further, both sodium and the chloride in plant leaves and roots and potassium deficiency have been significantly increased by the salt stress, and further exacerbated sodium and chloride in leaves and plant roots. The content was higher, however, than those of the roots, of potassium, sodium, magnesium, and chloride, but the content of calcium sheets was lower than that of the roots. With greater reduction of combined stress than individual, the potassium/sodium proportion of the leaves and root has been reduced. The main reason for nutritional imbalances is the increased accumulation of sodium and chloride levels in various plant tissues. The accumulation in various tissues increases linearly with increased conductivity of electrically applied water or salinity levels of sodium and chloride concentrations. The accumulation of chloride was greater than Na^+ at low electric conductivity of the irrigated water, but the increased electric conductance meant a much higher accretion of sodium than Cl^- in plants and more sensitive to Na^+ acretion were plants than chloride.

The sodium levels in the apoplastic leaves of plants increased substantially with a higher supply of sodium. The level of sodium in the leaf apoplast was not high enough to cause the growth of the leaves to decrease under salinity. The concentration of apoplastic calcium was kept constant and the levels of potassium increased below salinity in the leaf apoplast In this regard the connection between high sodium in more seasoned plant leaves and the demise of the separate leaves was referenced in Fortmeier and Schubert (1995). Sodium amassing might be answerable for sodium poisonousness of leaves, especially in the leaf apoplast.

EFFECTS IN METABOLISM DURING SALT STRESS

Perhaps in ice plant (Mesembryanthemum), the most sensational change in the digestion is Under salt stress, glasslike).In days, salt stress in this succulent plant can result in a photosynthesis mode changing from C3 to CAM (crassulaceaic acid metabolism). A couple of long stretches of salt-stress prompt certain chemical hardware for CAM digestion, for example, carboxyllase phosphoenolpyruvate (PEP). CAM metabolism mainly advantages increased efficiency as stomachs are only available during the night when there is a minimum of evaporative water loss. The accumulation of organic low molecular weight under salt stress is a metabolic change common to most plants if not all. These solutes include linear polyols (glycerol, mannitol or sorbitol), cyclic polyols, amino acids (glutamate, proline) and betanes, as well as cyclic polyoles (glycine betaine or alanine betaine). Plants with frequent limitations of nitrogen may build up

The inorganic solutes, such as sodium and chloride ions, do not even harm high concentrations of the organic solutes to enzymes or cellular structures. Sulfonium compounds, e.g. dimmethylsulfonium propionate, are equivalent to the nitrogen-containing betains. Therefore, these organics are frequently referred to as osmolytes that are compatible. Compatible solutes work in osmotic adjustment at high concentrations. This is particularly true of halophytes, which frequently build up compatible osmolytes in the cells from between 0.5 and 4.0 mol L-1 The high grouping of viable osmolytes is fundamentally found in cytosol, tobalance the high salt focus outside the cell, both on one side, and on the other, all together not exclusively to counter the high centralizations of sodium and chloride particle in the vacuole. Encoding of genes for encoding polyol, proline and betane biosynthesis enzymes in the case of transgenic tobacco and A has been overexpressed. Thaliana. Thaliana. The compatible osmolytes are produced in the transgenic plants better than the salt plants. The osmotic adjustment theory cannot explain the protective effect fully since transgenic plants in most cases produce more than several millimoles per litre, which is too low in concentrations to significantly contribute to the osmotic adjusting process. It has been suggested that the low compatibility of the osmolytes can protect plants through the scavenging of salt stress free oxygen adicals. Experiments that show a good effect of the GM production of radical scavenging-enzyme-free oxygen on plant performance under salinity also reveal the importance of antioxidants for salt stress tolerance.

CONCLUSION

Salt stess is the most harmful abiotic stress that causes salt stress due to various factors, including human activity, because it reduces plant water consumption. The NA and CL ions also impede the assimilation of essential miniral nutrients in the plant. It has been shown that the assimilation of potacious and alcium, in particular, in the therooting medium of NaCl has been reduced, leading eventually to ion imbalance. The inhibition of cell division and cell extensions in the plants has been reported in salinity. Overall plant growth is also affected by salinity, which is why plants show stunning growth with salt.

REFERENCE

Salt stresss reference

https://link.springer.com/article/10.1007/s13593-015-0287-0#Sec3

https://www.sciencedirect.com/science/article/pii/S2095311916616088#:~:text=Salt%20stress%20has%20specific%20effects%20on%20plant%20cell,of%20a%20plant%20%28Munns%20et%20al.%202006%29.%203.2.

Alam SM, 1999: Nutrient uptake by plants under stress conditions. In Pessarakli M (ed) Handbook of plant and crop stress, pp. 285–313. Marcel Dekker, New York.

Asch F, Dingkuhn M, Dörffling K, Miezan K 2000: Leaf K/Na ratio predicts salinity induced yield loss in irrigated rice. Euphytica, 113, 109–118. doi:10.1023/A:1003981313160

Bartels D, Sunkar R 2005: Drought and salt tolerance in plants. Crit. Rev. Plant Sci., 24, 23–58. doi:10.1080/07352680590910410

De Leon TB, Linscombe S, Gregorio G, Subudhi PK 2015: Genetic variation in Southern USA rice genotypes for seedling salinity tolerance. Front. Plant. Sci., 6, 374. doi:10.3389/fpls.2015.00374

Deinlein U, Stephan AB, Horie T, Luo W, Xu G, Schroeder JL 2014: Plant salt-tolerance mechanisms. Trends Plant Sci., 19, 371–379. doi:10.1016/j.tplants.2014.02.001

El-Hendawy SE, Ruan Y, Hu Y, Schmidhalter U 2009: A comparison of screening criteria for salt tolerance in wheat under field and controlled environmental conditions. J. Agron. Crop Sci., 195, 356–367. doi:10.1111/j.1439-037X.2009.00372.x

FAO, 2016: Salt-affected soil. http://www.fao.org/soils-portal/soil-management/management-of-some-problem-soils/salt-affected-soils/more-information-on-salt-affected-soils/en/August, 2016).

Flowers TJ 2004: Improving crop salt tolerance. J. Exp. Bot., 55, 307–319. doi:10.1093/jxb/erh003

Flowers TJ, Yeo A 1995: Breeding for salinity resistance in crop plants- Where next? Aust. J. Plant Physiol., 22, 875–884. doi:10.1071/PP9950875

Grattan SR, Grieve CM 1999: Mineral nutrient acquisition and response by plants grown in saline environments. In Handbook of Plant and Crop Stress, Ed. Pessarakli M, pp. 203–230. Marcel Dekker, Inc., New York.

Corresponding Author

Ranju Gulati*

Department of Botany, DAV College, Chandigarh

ranjugulatidav@gmail.com