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Stress Affected Date Palm and Modified Treatments: A Review

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Abstract

Salt stress soil or water come to be the most problem and deficiency the crop yields, in spite of the fact that date palm (Phoenix dactylifera L.) can be tolerate high levels of salts, the acclimatized plantlets in the early stage facing stress just planted in the open field, however in the pre-acclimatization stage in vitro , also after acclimatization stage in the greenhouse these plantlets were adapted with different concentrations of salts NaCl, CaCl2 for helping them facing bad effects of salts in the fields, as well as many treatments can be done to ameliorate the bad effects of salts on the plantlets as hormons (IAA, GA3, cytokinins), yeast, amino acids, potassium K+ or Ca2+ and some of growth retardants, all of these treatments have important role to adverse bad effects of salts, enhancing growth as well as improving productivity of plants under salts stress.

Keywords: Date Palm; Effect; In Vitro; Salts; Stress

Introduction

Date palm (Phoenix dactylifera L.) which produced via tissue culture technique after acclimatization in the green house may be unable to confrontation the abiotic stress conditions when its cultured in the sustainable land i.e. salt stress, drought stress which caused bad effects on the plant growth characteristics as decreasing heights and length, leaves numbers, fresh and dry weights of aerial parts and roots. Na+- specific damage is associated with the accumulation of Na+ in leaf tissues and results in necrosis of older leaves. the date palm showed true halophytic adaptations to salt stress more than many other fruit trees [1], Soils classified to saline which saturated paste electrical conductivity (ECe) of 4 dS m-1, PH is less than 8.5, sodic soils defined that ECe of less than 4 dS m-1, and pH exceeds 8.5 15% and saline-sodic soils have ECe ≥ 4 dS m-1, and their pH is less than 8.5 by their chemistry, morphology, and pH (2) [2,3], Date palms are tolerated salinity stress than other cultivated trees to 4dSm-1 (EC (dSm-1) and a yield reduction per unit 3.6% [4], date palm is an important horticultural fruits in the arid and semi-arid regions and tolerant to salinity, which caused several types of damage such as growth inhibition and yield quality Del [5], date palms mostly found as trees growth in hot weather and salinity affected plants and some varieties of date palm can tolerate salinity levels up to 22000 ppm (EC 34 dS m-1) meanwhile their growth and yield productivity are affected, however, date palm cv [6]. Ruzaiz in vitro culture and offshoots tolerated salinity NaCl 1% , CaCl2, KCl at 0.2 M Al, date palm can tolerate abiotic stresses as drought, heat and soil salinity that markedly reduced fruits yields as well as the viable numbers of the date palm trees, 125 mM NaCl and higher, callus of date palm Phoenix dactylifera L [7]. cv [8,9]. Barhee, growth was inhibited; an increase in proline accumulation in response to increased salinity, proline accumulation was correlated to callus growth inhibition

[10], NaCl salt gave many bad effects etc., stunted growth, chlorosis of green parts, dry mass reduction and elongation as well as expansion growth of leaves [11], the weak plantlets of two other treatments (1.5 and 2.0%) NaCl were failed in growth and acclimatization of pineapple plantlets Hamed & Ali [12], Ibrahim [13], Abdallah, et al. [14] found that, 6000, 10000 and 14000 ppm NaCl + CaCl2 2:1 by weight which added to MS medium in vitro of date palm cv. Sakuti and cv. Zaghloul derived by tissue culture after two years from acclimatization stage, decreased all vegetative growth of the plantlets linearly with increasing salts levels as shootlet length, number of leaves, survival percentage of rooting stage, also decreasing vegetative characters in the rooting stage, moreover these plantlets were transferred into greenhouse after pre-acclimatized and all vegetative characters and acclimatization survival percent were significantly decreased with increasing salts, anions and cations reduced plant growth root and shoot development and yield morphological parameters like plant height, leaf production, root length and collar girth of different varieties which subjected to high salinity irrigation showed differential responses (56) long term irrigation with very high EC of irrigation water (8 and 12dSm−1) severely reduced growth and yield of date palm cv [15-19]. Medjool NaCl from 50-250 mM supplemented in MS media of date palm cvs Barhi', 'Zaghlool' and 'Barban which were affected by salt stress as decreasing of root growth particularly with high level, while Zahdi' and 'Majhool' exhibited higher tolerance [20-23].

Effects of Salts Stress on the Chemical Contents

Ions

reduction in K + concentration in plant tissue due to the antagonism of Na + and K + at uptake sites in the roots, the influence of Na + on the K + transport into xylem or the inhibition of uptake processes, NaCl in the soil solution , the levels of K in plant were reduced related to the antagonism between Na and K after evaporation of salty water (Ca2+, Mg2+ and Na+) Ca2+ and Mg 2+ were precipitate to carbonate remain Na+ in the soil increased availability of Na and Cl, under salt stress contribute to reduced uptake of N, P, and K salinity stress by increasing concentration of Na+ in the soil, Na+ ion competes with K+ for the transporter as they both share the same transport mechanism, thereby decreasing the uptake of K+, Sodium, K+ and Cl- were the main inorganic solutes that contributed to osmotic adjustment, Na+ replaced K+ as the main cation, particularly in the proximal region of the growth zone, K+, Ca2+ and K+/Na+ ratio in canola decreased by salt stress, but significantly increased of Na+ and Cl- content in the roots, shoots and leaves, N/K+, K+/Na+ ratio, Ca2+ and Mg2+ content of date palm cvs , Khalas, Madjol and Barhy young leaves, stem and roots were decreased with increasing levels of salinity (200 and 400mM) , while increasing of Na+ and Cl- content [1, 2, 4 and 6 dsm-1 (ds/m) on dwarf apple rootstocks (M.pomila) led to increased Na and Cl in leaves while decline in the K, N and Cu concentration in leaves of plants also reduction of P, Fe, B, Zn and Mn [24-31].

Affecting photosynthesis process and products as amino acids, enzymes: factors reduced photosynthetic rates i.e. enhanced senescence, changes in enzyme activity, induced by alterations in cytoplasmic structure and negative feedback by reduced sink activity more than alteration of photosynthetic pigment biosynthesis, (94), (95) [33], salinity associated with a marked inhibition of photosynthesis, reduction in water potential and accumulated Na+ and Cl- in the chloroplast which affects photosynthetic components such as enzymes, chlorophylls, and carotenoids and membranes which the primary sites of injury under stress, photosynthesis was the primary affected by salts and drought stress, Water stress induced stomatal closure, reduced net CO_2 assimilation rate and the intercellular CO_2 availability in mesophyll, also reduced the photosynthetic efficiency, on the other hand antioxidant enzymes and stimulated the production of antioxidant metabolites and preventing lipid peroxidation [32-39]. It was found that stress can be strongly affected enzymes in this respect many scientists showed that enzymes antioxidant activity proved to the mechanism tolerant salts as SOD and CAT which they found in cell compartments in stressed plants and ascorbate peroxidase (APX) have important function against oxidative stress [40], CAT activity in *suaeda salsa* increased under 200 mM NaCl [41] and peroxidase (POX) in rice [42], the increasing activity related to lowered H2O2 level and POX activity appears to be caused either by activation of existing enzymes isoforms, antioxidant enzymes catalase (CAT) and peroxidase (POD), , POX, APX were significantly higher under severe salt stress in *Pancratium maritimum* plants, protect plants against damage oxidative of NaCl (Sanaerirad [43] on Salsolacrassa) [44], In the date palm induction of enzymes as PdCAT, PdGR and PdMDAR were observed at NaCl (100mM, 200mM, 300mM and 400 mM 100 mM NaCl these observation suggest that antioxidative enzymes involved in either ROS detoxification or antioxidation, and have important role the tolerance of date palm to salt stress [45-47]. Protein synthesis and lipid metabolism are affected under stress, positive antioxidant response might be responsible for a higher tolerance to flooding stress in

Carrizo citrange *Poncirus trifoliata* L. Raf. x *Citrus sinensis* L. Osb. and Citrumelo CPB 4475 *Poncirus trifoliata* L. Raf. x *Citrus paradisi* L. Macf the photosynthesis and respiration rate of plants decreased under salt stress also total carbohydrate, fatty acid and protein content, moreover increasing levels proline was found, meanwhile Proline accumulation which is a known measure adopted for alleviation of salinity stress [48-52].

Stress Affecting Stomata and Pigments

Under salt stress plants has to close their stomata due to water loss [53], stomatal closure induced by synthesis of ABA which act as ameliorative responses include maintenance of root water uptake, the synthesis of osmoprotective proteins Cl - -induces chlorotic toxicity due to impaired production of chlorophyll (Chl) [54], critical levels for toxicity to be 4-7 mg g −1 for Cl - -sensitive species and 15-50 mg g −1 for Cl - -tolerant species [55], decreasing rate of photosynthesis occurred at high salinity, also inhibited cell expansion and cell division stomatal conductance and closure in *Bruguiera parviflora,* decreases in contents of chlorophyll (a), (b) & (a + b) carbohydrates, soluble proteins and Sofy & Fouda [56] on Helianthus tuberosus L.), these severe effect of stress on pigments according to the time of stress exposure [57], moreover demonstrated that the reduction in chlorophyll contents under salt stress caused by inhibitory effects of the accumulation ions Na+ and Cl- on the biosynthesis of the different chlorophyll fractions, Chlorophyll responsible for photosynthesis moreover under adverse conditions, chlorophyll contents is a good indicator of photosynthetic activity [58,59], assimilation of CO_2 decreased also stomatal conductance and plant transpiration were reduced similarly in all three Lemon (Fino 49) salt treatments50 mM NaCl [60], under salt stress less chlorophyll contents and highly of accumulation of Na and Ca under salt stress 100-200 mM El- Bagoury, et al. [61] on Casuarina equisetifolia L.), total chlorophyll decreased with exposure to NaCl (20, 40, 60, 80, and 160 mM) in WPM culture medium at 15 and 30 days in *Paulownia imperialis* (Siebold & Zuccarini) and *Paulownia fortunei* (Seemann & Hemsley), proline content in P. imperialis significantly increased under 20 and 40 mM NaCl The decrease in Chl content under salt stress is a commonly reported phenomenon were used as a sensitive indicator of the cellular metabolic state [62,63], salt soil resulted in 41% reduction in ch b compared with 75 and 33% reduction of ch a under NaCl from 100 to 200 mM for 14 days of Oryza sativa [64], salt stress the reduction in photosynthesis pigments related to increasing destructive enzymes as chorophyllase activity or by weakening of protein-pigment-lipid complex in addition stress can reduce cell division [64- 66], furthermore depressing of the rate of photosynthesis and related enzymes activity, suppresses chlorophyll synthesis [67].

Reactive Oxygen Species (ROS)

Salinity stress have severe injury caused by ROS is known as oxidative stress, which is one of the major damaging factors to plants, ROS cause peroxidation of polyunsaturated fatty acids in the membranes [68], which include the superoxide anion radical $O2^-$, hydroxyl radical OH^- and (H2O2) hydrogen peroxide [69], antioxidant and enzymes as carotenoids, ascorbate, glutathione and tocopherols, superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPX), peroxidases, ascorbate peroxidase can inhibited damage were found by ROS under salts stress scavenging enzymes SOD, APX and POX improved tolerance to abiotic stresses as salinity which produced high levels of ROS [70,71], reactive oxygen species (ROS) responsible for cellular oxidative caused damage in cell machinery and chloroplast ROS which produced normally from cell metabolism however, these products under stress defected biomolecules and cell metabolism and led to cell death [72-75], ROS have important role in the plant cell to reduce forms of atmospheric oxygen, four electrons are required to oxygen reduction ROS results from the transference of one, two and three electrons, respectively, to O_2 to form superoxide (O_2·-), peroxide hydrogen (H_2O_2) and (HO·) hydroxyl radical [76], in addition, increasing ROS production result from stomatal closure, causing a decrease in CO2 concentration inside the chloroplasts, on the other hand ROS increase in the salt sensitive plants were removed by antioxidative mechanisms in the normal condition, but this removal can be impaired under salt stress [77,78]), excess amounts of ROS caused and cellular toxicity in citrus (168) [79], ROS, such as (singlet oxygen 1O2), hydrogen peroxide H2O2, superoxide O2·- and hydroxyl radical HO·, are toxic molecules capable of causing oxidative damage to proteins, ROS detoxification are antioxidants as ascorbic acid (AsA) and glutathione (GSH), and ROS-scavenging enzymes as superoxide dismutase (SOD), ascorbate peroxidase (APX), catalase (CAT), glutathione peroxidase [80], ROS generated during metabolic processes damage cellular functions lead to, senescence and cell death, these bad effect of ROS can be scavenged by antioxidant enzymes such as superoxide dismutase, calatase, peroxidase, Polyphenoloxidase and Glutathione Reductase, under salt stress excessive ROS caused adverse effects that exhibited from interaction with macromolecules, *Arabidopsis thaliana* treated with 300 mM NaCl for 72 h exhibited that plasma membrane oxidation in the cellular injury by production of ROS which may be cause cell death [81-87].

Modified Stress by Different Treatments

IAA, cytokinins tolerance plant to salinity by different mechanism i.e. osmotic stress tolerance, Na+ or Cl− exclusion, and the tolerance of tissue to accumulated Na+ or Cl− (16) [88], many attempts and modification treatments were done to decreasing these bad effects and trying to increasing yields under stress, osmoprotectants (proline, glycinebetaine, trehalose, etc.), plant hormone (gibberellic acids, jasmonic acids, brassinosterioids, salicylic acid, etc.), antioxidants (ascorbic acid ABA, glutathione, tocopherol, etc.), signaling molecules (nitric oxide, hydrogen peroxide, etc.), polyamines (spermidine, spermine, putrescine), trace elements (selenium, silicon, etc.) effective to mitigating the salt induced damage in plant [89-92], Phytohormones play important roles in regulating plant responses to stress which increased ABA and JA [93], numerous plant hormones as salicylic acid, abscisic acid, jasmonic acid and ethylene play a significant role in altering plant growth morphology in response to stress [94-95], wheat seedlings were more sensitive to water stress, meanwhile cytokinin activity (6-benzylaminopurine, thidiazuron, cartolin 2, and cartolin 4) played a protective role as increasing the stability of the photosynthetic machinery under conditions of water deficiency, enhancing cytokinin levels could plants reduced growth rates maintained by abscisic acid accumulation in stressed tissues [96-97].

5-aminolevulinic acid (ALA) have PGR properties which promoting plant growth under normal environments and stressful conditions and enhance plant tolerance to drought when applied at low concentrations, ALA showed to be essential biosynthetic precursor of tetrapyrrole compounds such as heme, cytochromes and chlorophyll, ALA as foliar spray 0.18-0.6 mM increased photosynthetic carbon fixation and reduced dark respiration [98-100]. ALA-based fertilizer Pentakeep-v improves salt tolerance in date palm seedlings by increasing photosynthetic assimilation, IAA from 54 to 97% significantly increased Wheat root growth under 100 mM NaCl , ALA at low concentrations can promote plant growth as exogenous application on spinach (*Spinacia oleracea*), Brassica napus and cucumber seedlings (201) [101-107], pretreatments of ALA at 2.11 µM or 2.57 µM The ALA under 50 mM NaCl increases of total chlorophyll and antioxidative activities of (CAT) catalase, (APx) ascorbate peroxide, (GR) glutathione reductase and (SOD) superoxide dismutase [108].

IAA, application of auxin IAA increased hypocotyls length, seedling fresh and dry weight and hypocotyls dry weight of wheat plants under salinity, in Z. mays plants, foliar application of IAA, especially at 2 mM, counteracted some of the salt induced adverse effects by enhancing essential inorganic nutrients as well as by maintaining membrane permeability, growth promotion in maize plants was associated with increased photosynthetic pigment and leaf Na+/K+ ratio to increased salt tolerance of plants which come out as growth and development can be regulate by cytokinins (CKs), auxins (AUXs), gibberellins (GAs), JA, brassinosteroids (BRs), ABA and SA [109-111]. Exogenous application of tryptophan and nicotinic acid at 200 ppm under 3000 and 6000 ppm salts can be enhancing growth parameters as height and fresh weight of *Allium cepa* L. [112, 113].

GA_3

Plant growth regulators as GA3, Zeatin and ethephon can alleviate bad effect os salts on germination and growth parameters of Ceratoides lanata, Salicarnia pacifica, Allenrolfea accidentalis [114], pre-treatment seeds with GA_3, IAA, Zeatin and Cytokinins increased and development of plant growth under salt stress [115], seed treatment of *Trichocereus terscheckii* (Cactaceae) with gibberellic acid improved germination percentage under saline conditions [116], Gibberellic acids (also called Gibberellin A_3 , GA, and GA_3) are generally involved in growth and development; they control seed germination, leaf expansion, stem elongation and flowering (Magome *et al.* 2004, Kim and Park 2008), GA_3 at 20,25 and 30 mg/l ameliorated bad effect of salinity stress at 10000, 14000 and 16000 ppm under GA_3 at 20 and 25 mg/l the shoot and root length, number of leaves and roots were increased under levels of salinity Table 1 and 2, salt stress increased Na, Ca and Cl Table 3, salts decreased survival acclimatized while GA_3 increased this percent [117], GA_3 treatment in L. esculentum reduced stomatal resistance and enhanced plant water use at low salinity [118]. GA_3 -priming-induced increase in T. aestivum grain yield was attributed to the GA 3 -priming-induced modulation of ions uptake and partitioning (within shoots and roots) and hormones homeostasis under saline conditions [119] [119-120], GA_3 at 100 µM. Enhancing growth parameters of Barley and Wheat cvs under NaCl at 100 and 300 mM [121].

ABA (Abscissic acid) Osmotic stress induces and enhanced ABA biosynthesis as well as increased accumulation of the key ABA biosynthesis enzyme (NCED) 9-cis-epoxy-carotenoid dioxygenase [122], ABA have important role in plant osmotic stress response by a decreased pH led to induction of turgor loss in stomatal guard cells leading to stomatal closure [123], High K+/Na+ ratio was observed due to abscissic acid (ABA) treatment given to common bean plant that seems to limit sodium translocation to shoot [124].

Amino Acids

Protects the higher plants against osmotic stresses not only by adjusting osmotic pressure by many compatible solutes which are small molecules, water soluble and uniformly neutral with respect to the disturbance of cellular functions, even when present at high concentrations as well as [125], carbohydrates in stress mitigation involves osmoprotection, carbon storage also increases the level of reducing sugars as sucrose and fructans [126], Compatible osmolytes and proteins used as potential biochemical which were useful in the salt-resistant of plant cells [127], photosynthetic apparatus protection [128], and reduction of ROS [129], Proline accumulation rises in response to salinity stress also involved in cellular structures Solomon, et al. [130] on *Tamarix jordanis*), induced significant increase in chlorophyll and total soluble sugars contents , proline protect plants under stress by stabilizing many functional metabolism as complex II electron transport, membranes, proteins and enzymes such as RuBisCo [131], Proline improves salt tolerance in *Nicotiana tabacum* plants by increasing the activity of enzymes involved in the antioxidant defense system [132], by protecting the photosynthetic apparatus [133,134], exogenous Pro 5 mM and 100 mM NaCl in Citrus sinensis 'Valencia late', increased growth of this salt sensitive citrus cell line stated that, the applications of proline 30 and 50 ppm were diminished the harmful effects of salt stress 16000 [135-137], 18000 and 20000 ppm NaCl + $CaCl_2$ as plant height (cm), number of leaves/seedling, root length (cm), roots number/seedlings and fresh and dry weights of *Phoenix canariensis* , significant increase in total amino acids Na, Ca and total amino acids obtained by the treatment 20000 ppm, In addition yeast have important components that have increasing growth which can ameliorated bad effects of salts as application of yeast and amino acids had significantly ameliorated the harmful effects of salinity which accompanied by markedly increase in all studied growth parameters plant height, leaves numbers, fresh and dry weights of leaves particularly at 50 cm/l yeast and 6 cm/l amino acids compared to control treatment (salts only) [138]. Na, Ca and Cl were increased, while under salts chlorophyll a and b decreased under salt stress while increased with yeast and amino acids, closely positively relation between salt stress and the anti - oxidative enzymes catalase (CAT) and peroxidase (POD) which was significantly enhanced in the presence of salinity levels, antioxidant enzymes were had the defense system for salt tolerance in a lot of plants.

Glycinebetaine (GB) and putrescine, glycine betaine protects the cell by osmotic adjustment [139], one of compatible solutes that has an osmoprotective function and improve salt stress tolerance in most crop plants [140] GB may have a positive impact on both absorption and translocation of monovalent cations in salt-stressed, the positive effect of exogenous GB was associated with reduced Na + accumulation and with the maintenance of K + concentration, triggering the antioxidant defense and also glyoxalase System [141-142] , polyamines a foliar spray minimize the adverse effect of salinity [143], furthermore, foliar application of putrescine (1.25 mM) accumulation of putrescine under salt stress, the possible physiological role of putrescine in alleviating stress damage [144], organic metabolite soluble in water and non-toxic at high concentrations which can potentially play a protective role against salt stress [145], it has found that arginine and GB can adverse bad effect of salts 4500, 15000, 3000, 4500 and 6000 ppm by stabilized proteins also the main function that protects the photosynthesis system from damage [146] on Mung bean (*Vigna radiate* L and Cha-Um & Kirdmanee [147], growth and nutrients of citrus rootstock Karna khatta (*Citrus karna* Raf.) were enhancing with putrescine and paclobutrazol application under salt stress [148,149]. Jasmonic acid (JA) and its methyl esters are ubiquitous in plants and have hormone properties. Jasmonates found as important roles in salt tolerance, SA and JA are synthesized in the osmotically stressed mesophyll cells of leaves under regulation of ABA [150], jasmonic acid at 30 μM enhancing tolerance of rice under 40 mM of NaCl [151-152], these are important cellular regulators involved in diverse developmental processes, such as seed germination, root growth, fertility, fruit ripening, senescence and stomatal closure induced of JA in roots of citrus under drought stress conditions lead to progressive ABA accumulation in the plants which will induce later plant responses [153-157], Antioxidant (Ascorbic acid or Ascorbate (AsA), Citric acid or Vitamin C) and Glutathione (GlT): is an important antioxidant in plant tissue which is synthesized in cytosol of higher plants primarily from conversion of d -glucose to AsA. AsA has been shown to have an essential role in several physiological processes in plants, including growth, differentiation, and metabolism. It functions as a reductant for many free radicals, thereby minimizing the damage caused by oxidative stress. Plant with higher amount of AsA content showed better protection against oxidative stress. Ascorbate influences many enzyme activities, Citric acid consider as one of non -enzymatic antioxidants which act to eliminate free radicals produced in plants under stress [158-159], AsA (Ascorbic acid) plays an important role in plant stress tolerance. Under stressed condition plants showed different capacity of AsA metabolism which is due to the variation of AsA synthesis and regeneration. Different studies showed that AsA content in leaves of stressed plants tends to increase with increasing levels of salt stress reported that AsA concentration in leaves of *Momordica charantia* increased under NaCl stress as compared to control. Increase in AsA concentration due to salinity was reported by other researchers [160-162], it has been observed, tocopherols and ascorbic acid application provided enhanced tolerance to salt stress 15 ds/m also decreased the leaf senescence [163,164], exogenous application of AsA influences many enzyme activities and minimizes the damage caused by oxidative processes through a synergic function with other antioxidants [165-167], Glutathione (GIT) is a tripeptide (α-glutamylecysteinyl glycine), non-protein present as well as non-enzymatic antioxidants exhibited to improve seed germination and seedling growth under salt stress scavenge oxygen species reported that the application of vitamin C was effective to mitigate the adverse effect of salt stress on plant growth due to increased leaf area, improved Chl and Car contents [168,169], enhanced Pro accumulation and decreased H 2 O 2 content. In addition, application of ascobin with different concentrations not only mitigated the inhibitory effect of salt stress in both wheat cultivars, and increases in IAA, GA_3, cytokinins, photosynthetic pigments, total carbohydrates and polysaccharides contents Mervat, et al. [169] recently, exogenous 1mM of ascorbic acid with 3 mM NaCl on *tomato* improved and ameliorated bad effects of salts stress as chlorophyll a and b, shoot and root length and fresh and dry weights of shoots [170,171].

Salicylic acid (SA) is a common plant-produced phenolic compound and a potential endogenous plant hormone that plays an important role in plant growth and development. The role of SA is intensively studied in plant responses to biotic stress. SA application under salt stress enhancing synthesis of chl a, b and carotenoids, maintained membrane integrity also led to less contents of Ca2+ and act to accumulate K+ and soluble sugars which caused increasing of photosynthesis process [172,173], Arabidopsis tolerance salinity with SA by restoring membrane potential and preventing salt-induced K+ loss from guard cell outward rectifying K(+) (GORK) also SA can upregulation of H+-ATPase activity, which improving K+ retention during salt stress moreover pretreatment of SA can reduce the concentration of accumulated Na+ in the shoot [174], also SA caused accumulation of ABA and IAA [175], another methods as (soaking the seeds prior to sowing, adding to the hydroponic solution, irrigating, or spraying with SA solution) have been shown to protect various plant species against abiotic stress by inducing a wide range of processes involved in stress tolerance mechanisms via enhancing activity of antioxidant enzymes Salicylic acid can enhancing antioxidant enzymes activity i.e. POD, DOD and SOD in tomato as spraying under drought and salinity stress A foliar spray of SA at 1.00 mM promoted the plant growth under 50, 100, or 200 mM NaCl , activity of antioxidant enzymes, as catalase [176-181], peroxidase, and superoxide dismutase, were enhanced by SA treatment Aftab, et al. [182], Habibi [183], Misra & Misra [184]on Rauwolfia serpentina), [185-186], salicylic acid application 0.75, 2.5 and 5.0 mM improved tolerance of Eucalyptus globulus by improving water potential with increasing photosynthetic rate, soluble sugars under water deficit 5% and chlorophyll a Jesusa, et al. [187], Nimir, et al. [188] on Sorghum bicolor), in this respect proved that, salicylic acid at 400 ppm and IAA at 30 ppm were enhanced growth estimations i.e. plant height, leaves numbers, fresh and dry weights of leaves. Whereas these parameters were significant reduced under salts 14000 ppm NaCl, chlorophyll a and b was decreased, At saline conditions, increasing of, proteins, catalase activities (CAT) and peroxidase activities (POD) which act as defense effects in the plants exposed to salinity stress, Na+, Ca2+, Cl- and K+ leaf concentrations were rising under 14000 ppm NaCl [189].

different ions can ameliorated bad effect of salt stress: supplemental Ca alleviates the inhibitory effect of salt on cotton root growth by maintaining plasma membrane selectivity of K over Na [190], adding at least 5-10 mM Ca to the medium for salinities of 100-150 mM NaCl, to counteract the inhibitory effect of high Na concentrations on growth [191-192], Supplementing the Ca2+ can alleviates growth inhibition by salt in glycophyte plants. Ca2+ sustains K+ transport and K+/Na+ selectivity in Na+-challenged plants Sohan, et al. [193] Ca^{2+} can be ameliorated bad effect of stress as rising shoot growth and root elongation, as well as reduced Na+ accumulation and increasing uptake of K+, however this effect related to its function of membrane and cell elongation and division [194,195].

(S)sulphur date palm cvs Sewy, Zaghloul and Hayany treated with 1088 ppm soil salinity with soil addition of sulphur 100 mg/l, spraying of citric acid 500 ppm and salicylic acid 100 ppm, effective microorganisms (EM) 50 ml/tree/year, humic acid 50ml/tree/year, compost enriched with actinomyces 5 kg/tree/year and filter mud

5 kg/tree/year all of these anti salinity can be ameliorated the adverse effect of salinity on bunch numbers and weight , TSS and sugars [196], sulphur at level of 200g caused a significant increase height, leaf area, number of leaves and girth of date palm cv. Berhi under saline treatment EC soil (15.93 dS m-1) and to EC water (4.55 dS m-1) Also, sulphur increasing total Chlorophyll, Dry weight, Carbohydrates, proline and soluble protein, peroxidase enzyme activities and (IAA) content [197,198].

N,K and P KH2PO4 can ameliorated effects of salts by improved ratio of Na/K in spinach, as well as KH2PO4 can correction the deficiencies of P and K that mostly found under salts stress, KNO3 at 250 mg/l increased weights of Lagentaria siceraria [199, 200], different levels of KNO3 from 0.5 to 3.2 % improved growth of Sunflower under 150 mM NaCl also increased photosynthesis rate [201], existence of 50 mM NaCl potted plants Supplemented with nitrate KNO3 at 10 mM that increased leaf number and area Citrus reticulate × Citrus limetta] (Valencia/Bakraii) and Carrizo citrange [C. sinensis × Poncirus trifoliata] (Valencia/Carrizo), stem elongation, Chl contents and stimulated photosynthetic activity, from this nitrate ameliorated the deleterious effects of NaCl stress Phosphorus fertilization reduces of Na+ in shoots and increased growth and yield in rice and sunflower [202,203], shoot and root fresh and dry weights, chlorophyll contents, different ion accumulation and yield components of wheat were increased when treated with spraying phosphorus at , 400, 800 mg/L or potassium in the presence of 150 mmol NaCl Khan, et al. [204], Rasmia & El Banna [205] on date palm.

Selenium (Se) which stimulate the growth, the activities of SOD and POD, as well as the accumulation of water soluble sugar [206], however, Se at 5 and 10 m M significantly improved growth rate protecting the cell membrane against lipid peroxidation and increased the photosynthetic pigments and Protein contents, in addition Se proved as stimulate enzymatic and non-enzymatic antioxidant, reduce Na + uptake and enhanced K + uptake, K + : Na + selectivity under stressful condition, [207,208], Si was mitigate salinity stress by enhancing Na + exclusion and decreasing lipid membrane peroxidation through stimulation of enzymatic and non-enzymatic antioxidants Silicon, the silver bullet for mitigating biotic and abiotic stress [209,210], and improving grain quality, in rice? Environmental and Experimental Botany 120:8-17), addition of Si to salt stressed plants alleviated the adverse effects of NaCl on growth Glycine max, as it enhanced endogenous GA_3, while reducing the levels of ABA and Pro found that Si supplementation at 0.5, 1, 1.5, 2, 2.5 mM into salts at 120 mM significantly improved fresh and dry weight [211-212], protein contents and catalase activity and numbers of trichome and stomata. of Borago officinalis L, exogenous of selenium at 0, 2, 4, 8, 16 µM enhancing growth and performed as antioxidant by inhibiting lipid peroxidation and increasing in SOD and POD enzymes activity with 100 mM NaCl Keling, et al. [213] on Cucumis melo L. and Hasanuzzaman, et al. [214], Nawaz, et al. [215], [216-230].

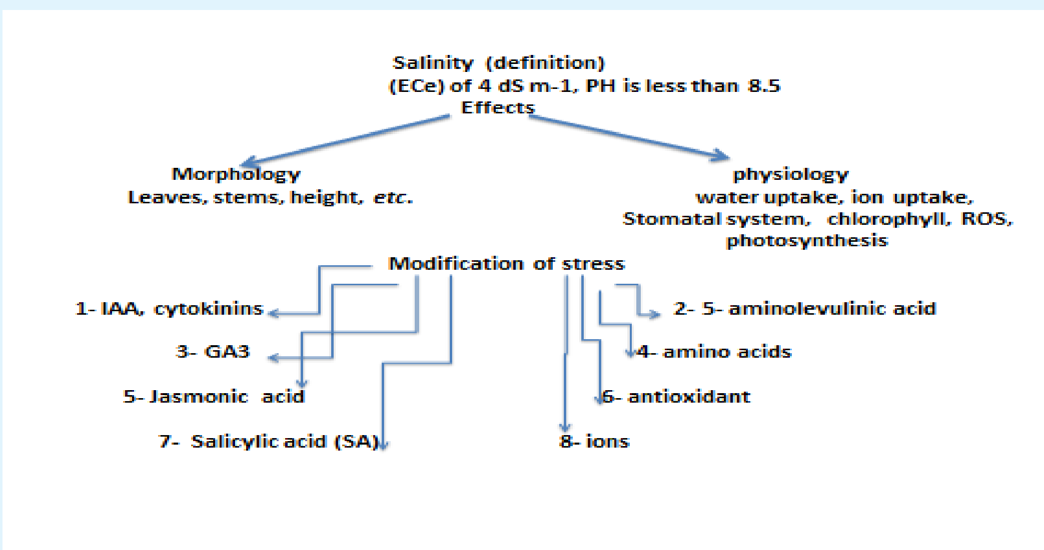

Figure 1: Salinity effects.

Conclusion

In general salts (soil or water) ranked as the most stress affected growth and productivity of many crops in all culture area of the world, this stress can modified by different treatments as IAA, GA3, yeast, amino acids, minerals as potassium, calcium in addition some of growth retardants, all of these treatments can be enhancing growth and developments of crops under stress.

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