Review Article

Impact of ~~Soil~~ soil salinity on citrus: A Review

Abstract

Citrus fruits are one of the most important fruit crops in the world. However, ~~it is~~these are vulnerable to a variety of environmental stresses, including drought, over watering (water logging), extreme temperatures (cold, frost, and heat), salinity, and mineral toxicity. ~~Of all of~~Above these factors, salinity ~~stress~~ is the one of the most significant. Because of its hyperosmotic and hyperionic effects on the soil rhizosphere, salinity is an abiotic factor that has ~~the~~ detrimental effect of reducing plant development and yield. Citrus is a salt-susceptible crop as compared to other fruit crops, because citrus development and yield are dramatically reduced under salt stress conditions. There are a variety of approaches that can be used to mitigate the harmful effects of salinity, including alternative irrigation and the selection of salt-resistant root stocks. This review will therefore, concentrate on the influence of soil salinity on citrus production and feasible mitigation techniques to reduce production losses.

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Keywords: Citrus**,** losses, rootstocks, salinity, ~~stresses~~

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Introduction

Citrus is a subtropical fruit crop that is cultivated in almost every part of the world. In India, citrus is cultivated over an area of 1.05 million hectares with an annual production of 13.97 million tonnes per hectare. In terms of area and production, mandarin oranges are the most widely planted and harvested citrus fruits, followed by sweet oranges, acid limes, lemons, grapefruit, pummello, and other varieties. When grown in poor soil or at low temperatures, it is more susceptible to disease and pests. Citrus is primarily produced in the northern hemisphere, in Mediterranean countries, and in the United States, with Brazil being the greatest citrus producing country in terms of production. Citrus production is more successful in locations with warm temperature conditions and well-drained soils than in other areas. For citrus growth and

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development to thrive, it is necessary to have supplemental irrigation as well as better quality irrigation water. The application of chemical products and fertilizers also promotes salt reinforcement in the soil, resulting in salt tension and other problems (Syvetrsen 1989). Citrus plants are adversely affected by river water used for irrigation because of the high concentration of soluble salts in the water as well as the high electrical conductivity (> 3 dS m^{-1}) in the water (Garca-Sánchez *et al.,* 2002). Citrus is a salt-susceptible crop because, as compared to other fruit crops, citrus development and yield are dramatically reduced under salt stress conditions (Maas 1993; Storey and Walker 1998). Abiotic factors that have a negative impact on plant growth include soil salinity, which is one of the most important abiotic factors. The nursery and greenhouse business is also under pressure to recover and recycle fertilizer solution and wastes, as well as other materials. The majority of these contain much greater levels of salt concentrations, which could be harmful to plant species that are sensitive to salt (Bilal *et al.*, 2020). The severity of salt stress is determined by the climate, the quality of irrigation water, and the condition of the soil (Grieve and Bevington, 2007; Prior *et al.*, 2007). It occurs as a result of insufficient soil drainage, boron toxicity, an excess or a lack of nutrients, and flooding. According to Camara-Zapata *et al.,* (2004), salt stress has a deleterious impact on all plants.

SALINITY AND SODICITY

Salinity, in the broadest sense, refers to saline soils and low-quality "saline" and "sodic" groundwater that are unfit for human consumption or crop irrigation. This type of soil contains an excess of soluble salts, principally Na^{+}, Ca^{2+}, and Mg^{2+} chlorides and sulphates. The soil saturation extract has an electrical conductivity of 4 dS m^{-1}, which causes "osmotic stress" and "specific ion effects" in the plants that are exposed to this type of soil. Saline soils have ESP values of less than 15 and pH values less than 8.2. Sodic soils, on the other hand, contain a high exchangeable sodium percentage (ESP > 15), which has a negative impact on water and air flux, water holding capacity, root penetration, and seedling emergence (Munns *et al.,* 2006, Sharma *et al.,* 2015). These soils exhibit fluctuating EC and pH values greater than 8.2. Sodic soils with an EC greater than 4.0 dS m^{-1} are frequently referred to as saline–sodic soils, despite the fact that their reclamation and management processes are quite similar to those of sodic soils. High Na^{+} levels in sodic soils cause other cations such as calcium, magnesium, and potassium to be released from their bonds with the clay particle, resulting in structural difficulties and low aggregate stability. Clay particles become less tightly bonded to one another, resulting in the dispersion of soil aggregates as a result of this. Sodic soils are characterized by surface crusting and hard setting, as well as flooding and oxygen shortage, which have an adverse effect on the emergence of crops and the growth of their roots. Clay dispersion also increases the compaction and power of the subsoil, which in turn limits the amount of water and oxygen that may reach the roots of plants (Davies *et al.*, 2009). Due to the fact that the plants are subjected to both salt and water stagnation stresses at the same time in sodic soils, their tolerance to water stagnation is crucial in addition to their salt tolerance. Although extensive salinization is a severe restraint on global agriculture (Al-Abdoulhadi *et al.*, 2011, Munns *et al.*, 2006), it is not the only constraint on global agriculture (Wicke *et al.*, 2011). According to some ambitious reports, there is significant potential for technology-driven gains in agricultural production (Wicke *et al.*, 2011) on slightly to moderately salt-affected soils, particularly in the short term. According to a recent study, approximately 85 percent of saline and sodic soils have only mild to moderate crop production constraints and can thus be productively used by capitalizing on the potential of existing technologies with appropriate adaptations. Sustainable improvements are possible if effective strategies for increasing the productivity of degraded lands are pursued in combination with efforts to stop the losses caused by secondary salinization. Before commencing on soil reclamation projects, it is essential to thoroughly evaluate the peculiarities of the ecosystem in order to fine-tune present techniques to meet the specific requirements of the site. When it comes to achieving long-term benefits, it is important to combine appropriate plant species, soil erosion control measures, rainwater gathering, and effective watering methods with everyday habits. In the majority of cases, the failure of soil reclamation and management projects is due to high costs, a lack of technical know-how, and practical difficulties in implementation. As a result, the emphasis should be placed on low-cost, long-lasting technologies to provide a long-term solution to this environmental menace in low-income countries that are confronted with insurmountable challenges such as fresh water scarcity, widespread land degradation, poverty, and inadequate policy support (McWilliams *et al.*, 1986, Sharma *et al.*, 2015).

Salinity Impact on Citrus Growth and Production

Salinity is the primary abiotic element that stimulates vegetative growth and yield in plants by causing hyperosmotic and hyperionic effects in the soil rhizosphere, respectively. Syvertsen *et al.*, (2014) discovered that salt stress is exacerbated by nematodes, bacterial disease, and root rot, which are all caused by roots that predispose trees to biotic environmental stress. Balal *et al.* ,(2011) investigate the impact of salt stress on plants. The findings revealed that increasing salinity concentration causes an unnecessarily decrease in growth parameters, such as dry and fresh root and shoot weight, and that increasing salinity concentration also causes an increase in sugar and proline contents. Wei *et al*. (2013) investigated the effect of citrus salt tolerance on fruit quality. Dry mass (DM), leaf area, and transpiration rate are all reduced when the sodium chloride concentration is increased, but the leaf transpiration rate (Tr) of loose-skin mandarins is lower than that of sweet oranges. In order to suggest less leaf decline in Mg^{2+} and Ca^{2+}, the difference in basic nutritional value between salted cultivars and loose skin mandarins was varied between the two types of fruits. Using increased salt Beranium, it was discovered that the ability to exclude Na^{+} and Cl^{-} from leaves, as well as the presence of Mg^{+} and Ca^{2+} in their leaves, is likely to be associated with the presence of weak-skin mandarins. Several researchers, including Gimeno *et al*., (2009) conducted a research trail to investigate the impact of salty water irrigation in semi-arid and arid areas. Fertilization and rootstocks have been shown to play a significant role in the tolerance of citrus to salt. The salinity decreases, and the growth of the leaves was identical in S + N and S trees, respectively. In order to explain this, it was discovered that the osmotic effect and the sensitivity of Cl^{-} and Na^{+} leaves played a critical role in the salt stress growth response of the fino lemons. Also stated that foliar spray concentrations of Cl^{-}leaf nitrogen were lower in S+N treatment when compared to S treatment, but that leaf growth was lower in the N treatment of nitrogen-fixing crops. Salt reduced the amount of water lost by the leaves while increasing the osmotic ability of the leaves to improve their turgor. According to Garca-Sánchez *et al.*, 2006 they conducted a research trail to assess the impact of various salinity concentrations on citrus and discovered that the exchange of leaf gas and growth of the leaves were both inhibited. They discovered that shade reduced the amount of salinized tree leaf applied, but that it had no effect on the root or leaf Cl^{-} of cleoptera trees. There are no statistically significant differences in the leaf gas exchange parameters of salinized plants grown in shade and those grown in the open. The salinity, which has been reported to be superior to that of un-shaded plants, has also had an effect on the production. Although shading has been tried, it has failed to mitigate the negative effects of salinity on Na^{+} accumulation and development. They also reported that shaded trees grow at a faster rate than un-shaded trees, indicating that shaded trees grow at a faster rate than un-shaded trees. The harmful effects of salinity on Na^{+}

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accumulation and growth were not mitigated by the use of shading. Adnan2004stated that water salinity was the primary source of concern because of the negative impact it has on the yields of many horticultural crops. It has a negative impact on the development of citrus trees and also causes physiological problems. Salinity ~~stress~~, in addition to accumulating extremely high chloride or sodium concentrations in the leaves, has a negative impact on the integration of net carbon dioxide into the atmosphere, transpiration rate, and the presence of future citrus leaves in the water. As a result of their research, they conclude that citrus is genetically sensitive to salt, according to the best studies. Sodium chloride (NaCl) was used to test the influence of several citrus rootstocks in the greenhouse, and the experiment was carried out by (Zekri and Parsons 1992) in the greenhouse. By raising the concentrations of sodium chloride in the nutritional solution, the mineral levels in the leaves and roots of the seven citrus rootstocks are significantly and separately enhanced, respectively. Several citrus rootstocks have shown considerable differences in both leaf and root concentrations when grown under poor conditions, according to the researchers. According to them, several citrus rootstocks are more sensitive to sodium chloride than others, as evidenced by the presence of leaf burning symptoms and growth inhibition in the presence of Cl^- compared to Na^+. In contrast to the sodium and CI concentrations found in the roots of seven citrus rootstocks, the sodium and CI concentrations found in the leaves were higher. For the purpose of determining the impact of the greenhouse experiment NaCl, (Zekri 1993) conducted an experiment in which he applied pressure to the early development and emergence of citrus rootstock cultivars, including Cittrumelo, Rough lemon, Lemon Volkamer, Lime Rangpur, and Citrumelo Swingle, in order to investigate its effects. The seeds were watered with a solution containing sodium chloride at varied concentrations. There were significant effects of salinity on seedling growth and emergence, but there was no effect on the final rate of emergence, according to the data. Researchers discovered that sour orange and rough lemon produced the fewest results in terms of tolerance, whereas Rangpur lime and Swingle citrumelo produced the strongest results.

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Generally speaking, plant "salt tolerance" refers to the willingness of plants to withstand the consequences of excessive salt in their root zone. A large difference exists between crop species in terms of the range of salt levels that they can handle. Several studies have demonstrated that osmotic stress is the most important factor influencing fruit production losses when there is no excessive accumulation of Cl^- or Na^+ in the fruit or any visible indicators of toxicity. By increasing salt in the root zone, the growth of trees on all rootstocks has been slowed significantly. On the Cleopatra mandarin and macrophylla rootstocks, this effect is stronger than on the sour orange rootstocks, which are more prevalent on those plants. The loss in fruit yield was shown to be mostly due to a reduction in the number of fruits produced per tree, rather than a reduction in the weight disparities between fruits. An estimated tolerance limit for salinity in the root zone of 'Valencia' oranges is between 2.5 and 3.0 dS m^{-1}. Citrus species development and fruit yield were shown to be reduced in the presence of soil electrical conductivity (EC) greater than 1.4 (dS m^{-1}) in most cases.

Salinity Impact on Production and Efficiency of Crop Citrus

The citrus crop is susceptible to stress from salt. Saline water irrigation reduces the yield of the citrus crop. (Hepaksoy 2000) carried out a research trail to verify the yield and consistency of saline rootstocks. They found that fruit yield of citrus crop was decreased by approximately 13 %, 1.0 (dS m^{-1}) higher in electrical conductivity of the saturated soil extract when soil salinity is overshot a threshold electrical conductivity of 1.4 (dS m^{-1}). Specific ion toxicity may be affected by the accumulation of high Cl^- and Na^+, but the selection of various rootstocks can solve this issue. The harmful effects of salt stress were investigated by Ashutosh *et al.*, 2005 and degradation in fruit quality and yield was reported. They observed that the feasible process (nutritional, biochemical, physical) modified by plants to assist salt stress could give biotechnologists and plant breeders a signal to start further in the production of crops. In vitro research has been carried out by Sharma *et al.*, 2013 to investigate the effect of salt stress on the development of raw lemon seeds. The seeds were treated with varying amounts of sodium salt. The findings showed that the tolerance index was found to be highest in NaCl and lowest in control treatments. In order to study indirect and direct ties between salinity and other physical abiotic stresses such as irradiance, drought, low soil drainage, leaf atmospheric evaporative demand and leaf temperature, Syvertsen *et al.*, 2005 conducted a research trail on citrus. In accumulation, salinity applies to biotic parasites and diseases containing Nematodes, root rot (*Phytophthora* spp.) and mycorrhizae. Refining the association of tree water by ideal irrigation management, reducing evaporative claims, and maintaining nutrient balances can improve salt injury and decrease the accretion of harmful ions. They reported that citrus rootstocks may also be disposed of by salinity to ambush nematodes and root rot. However, not all salinity properties are negative, as modest salinity stress can reduce growth and physiological activity, allowing

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citrus seedlings to survive under cold exposure, and may also boost vegetation after salt stress is released. Abadet *et al.*, 2002 conducted research to check the impact of salts and observed that salinization decreases the dry weight of the plant higher in Sour orange compared to citrus plants in Cleopatra mandarin. They also stated that there is no link in the shoot fresh weight and leaves decreasing between Na^+ and Cl^- concentration. Salinity affects the overcoming of Ca^{2+}, K^+ and total nitrogen in citrus cultivars of Cleopatra mandarin leaves and higher K^+ in Sour orange leaves. Gregorio *et al.*,2003 judge the influence of salinity on uptake, growth, accumulation of Na^+ and Cl^- ions and transport in the stem, leaves and root of two rootstocks, *i.e.*, Sour orange and C. macrophylla. The results showed that in response to escalate salinity, shoot and root attentiveness of Na^+ and Cl^- improve in sour orange, but not in *C. macrophylla* and also suggest that *C.* macrophylla and sour orange have the dissimilar structure for transport and uptake of Cl^- and Na^+.

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Managing Salinity in Citrus

Citrus is a fruit crop that is susceptible to salinity; nevertheless, depending on the region, scion cultivar, rootstock, and irrigation-fertilizer management, appropriate production can be accomplished with low levels of salinity. Irrigation scheduling is a critical component of salinity control in locations with salinity issues. Increase irrigation frequency and apply water in excess of the crop water demand to leach the salts and reduce the salt content in the root zone. Overhead sprinkler watering should be avoided when utilizing water with high salt levels because salt residues can collect on the leaves and cause serious harm. Using micro irrigation systems, much of the leaf and trunk damage caused by direct foliar salt intake can be reduced. For frequent fertilization at low rates, fertigation or broadcasting of dry fertilizers is advised. The salt index of nutrient sources should be low, and they should not contain chloride (Cl) or sodium Na. In locations where Na accumulates in soils, calcium (Ca) sources (e.g., gypsum) have been found to minimize the negative effects of Na and increase plant growth under saline conditions. Another important strategy for managing salinity is adapting plants to saline circumstances and enhancing salt tolerance through breeding and genetic modification.

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Salt tolerance

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Citrus is a salt-sensitive crop because it can have problems with its growth and fruit yield even at low levels of salinity. Citrus can handle a moderate amount of salt without much damage, depending on the root stock, scion cultivar, climate, and irrigation fertilizer management. It has been thought that the ability of citrus plants to keep toxic ions separate and adapt osmotically makes them more salt-tolerant. Citrus is able to keep ions from getting into its shoots, which makes it tolerant of salt. Some citrus rootstocks have been found to not have some ions in them. Cleopatra' mandarin (*C. reshnii*) and limonia (*C. limonia*) appear to be rootstocks that don't allow Cl to get in. The rootstock Trifoliate orange (*Poncirus trifoliata*) and its hybrids may be able to keep Na out of the soil. This shows that there is a blocking mechanism that stops these ions from moving. Also, it's possible that citrus fruits that have been exposed to a lot of salt have different ways of taking in and transporting ions (Cl and Na). Many studies have shown that their ability to withstand salty soil varies from citrus rootstocks to other types of plants. In general, the decreasing order of salinity tolerance (most tolerant to most sensitive) is ‘Cleopatra’ mandarin, ‘Rangpur’ lime, ‘SB812’ (*C. sunki*x *P. trifoliata*), ‘x639’ (*C. reshni*x *P. trifoliata*), ‘GauTou’ (*Citrus* hybrid), ‘Volkameriana’ (*C. volkameriana*), sour orange, ‘Swingle’ citrumelo, rough lemon (*C. jambhiri*), ‘Carrizo’and ‘Troyer’ citranges (*C. sinensis*x *P. trifoliata*), ‘C35’ citrange, citron (*C. medica*). The above ranking may be adjusted somewhat by the scion's effect and the incompatibility conditions, Physiological or pathological ones that can be (viruses, viroids, root infections).

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Irrigation management

When the irrigation water is saline, the irrigation system has a considerable impact on the tree's productivity. Irrigation systems should be chosen based on three factors: salt distribution in soil, crop foliar wetting, and the simplicity with which it can be accomplished to achieve high osmotic and matrix potential. The salinity of the irrigation water, the soil, and the root zone should all be considered while implementing good irrigation management. Irrigation water with a chlorine concentration of 250 mg•L^{-1} When plants were irrigated at 40-day intervals instead of 18-day intervals, grapefruit output reduced by 28 to 32%. Salinity is more pronounced with lower soil water content, according to these investigations. Trees irrigated by sprinklers are harmed by salts in the soil as well as salts absorbed directly by moist leaf surfaces. Navel orange absorbed harmful levels of Cl^- and Na^+ from sprinkler-applied water with 500 to 900 mgL^{-1} TDSS. Excessive amounts of Na^+ and Cl^- and lesser concentrations of K^+ in the leaves have been linked to major leaf burning and defoliation of these plants. NaCl (NaCl), $CaCl_2$ ($CaCl_2$), or sodium sulphate (NaS) concentrations of 5 to 10 mmol L^{-1} in sprinkler-applied water caused leaf damage in navel orange trees (Na_2SO_4) Sodium chloride, calcium chloride ($CaCl_2$), or sodium sulphate

(NaS) concentrations of 5 to 10 $mmolL^{-1}$ in sprinkler-applied water caused navel orange trees to suffer leaf harm at these concentrations (Na_2SO_4). Sufficient leaching is required for effective irrigation management to control soil salinity. Irrigation rates should be managed to ensure that excess salts are leached beneath the root zone. The goal of leaching is to remove as much salt as possible and prevent it from building up to dangerous levels. Some vital nutrients may be lost if leaching is high. Perched water levels and poorly drained, thick soils can be difficult to leach appropriately due to their lack of permeability or drainage. Drip irrigation maintains low soil water tension and reduces salt buildup in the wet zone by delivering water at regular intervals. When the first rains come after a lengthy period of drought, extra care should be taken, especially with drip irrigation, to avoid salt damage. The salts that have built up on the soil's surface or around the wet zone's perimeter might be washed into the root zone by rain. Delaying irrigation even for a short amount of time will result in serious damage, most commonly defoliation, to the crops.

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Fertilizer management

There may be less damage from salinity because salt can produce nutritional imbalances by displacing certain nutrients (Boman and Stover, 2002). It's best to stick to a fertilizer schedule that includes frequent applications of salt-free fertilizer. Controlled-release fertilizers and regular fertization can help reduce salt stress when using high-salinity water. Soil salt stress can be minimized through the use of nutrients with low salt indexes. Fertilizer sources with high concentrations of Cl or Na [such as potassium chloride (KCl) and sodium nitrate ($NaNO_3$)] should be avoided in order to reduce compounding salinity issues (Boman and Stover, 2002). Soil nutrient imbalances can result from high salt application rates. Nutrient imbalances can also be caused by certain soil and tree-based ions and their interactions with each other. Thus, in soil, Na^+ replaces K^+ and a lesser extent Ca^{++} as the dominant cations. Repeated irrigation with water rich in Na may result in deficiency of K and, in rare situations, deficiency of calcium in leaves. Salinity stress can be exacerbated by nutritional imbalances. If correct nutritional levels, especially those of Ca and K, are maintained, salinity can be reduced. Plant development under saline circumstances can be improved by the addition of calcium. Calcium can be flocculated in soil that contains Na-dispersed clay particles and aggregates. Although salt-affected soils can be made productive through chemical alterations, drainage, and irrigation with high-quality water, the cost of such operations often exceeds estimates of returns from the land. Adding gypsum to the soil or irrigation water significantly reduced the amount of soluble Na in the soil and the amount of Na in citrus leaves and roots. To improve the growth of citrus seedlings, calcium sulphate ($CaSO_4$) was found to reduce the concentration of Na and/or Cl in the shoots, increase Ca content, and improve seedling emergence and development. An efficient way to reduce Na-induced stress in many crops is to employ improved K plant nutrition. Improved NO_3 fertilization is also an excellent tool for preventing chloride-induced stress in a variety of crops (Achilea, 2002). When trees were exposed to salinity (6.6-8 mM of Cl), their overall yields and canopy volumes decreased because the Cl and Na content of their leaves rose significantly. However, the detrimental effects of salinity treatments on trees were averted and yields improved by up to 38% by keeping a constant concentration of 2mM potassium nitrate (KNO_3) in irrigation water. The plant's accumulation of Cl was reduced and its negative effects were relieved by adding NO_3 to irrigation water. The accumulation of Cl and toxic symptoms as well as B concentrations in the leaves was also shown to be reduced by high NO_3 fertilization (Bar *et al.*, 1997). High Cl levels can be used for irrigation of citrus trees if NO_3 is given continuously at a concentration equivalent to half the Cl concentration, according to this study. Citrus fruits should have a NO_3 supplement added to them to prevent the unwanted B absorption.

Genetic improvement

Citrus salinity management requires careful consideration of cultivars, rootstocks, irrigation, and fertilization control (Levy and Syvertsen, 2004). But a long-term solution to salinity problems could be to breed and genetically modify plants to thrive in saline conditions. The rootstock exclusion of Cl is heritable, according to screening hybrid results. Since salt-tolerant wild cousins can't be classified and used, a breeding programme doesn't need to take into account the species' wide range of salt tolerance. Na and Cl transfer from the root to the shoot is restricted in citrus, like most glycophytes, which have a high tolerance for salt. As a result, breeding and selection that does not include genotypes for Cl- and Na will remain a viable area of study (Storey and Walker, 1999). However, breeding alone is unlikely to fix the salinity issues. Management of irrigation and drainage can be considered as part of breeding.

Application of plant growth substances

These endogenous hormones, such as auxins, gibberellins, and cytokinins (Murkute *et al.*, 2005), have been shown to play an important part in a plant's defense against stress. As a result, exogenous application of these and other plant development agents to reduce salt stress in a variety of crops has been tested. By enhancing stomatal resistance, the auxin indole acetic acid conserves water in stressed plants. Gibberellins are thought to play a role in ion homeostasis and altering the amounts of endogenous ABA in salinized plants (Prakash *et al.,* 1990). To mitigate the effects of salt stress, such as kinetin, cytokinins such as this one help to reduce toxicity symptoms, promote growth and up-regulate endogenous polyamine levels, which have a protective role in salt stress (Mansour *et al.,* 2000). Polyamines, the ubiquitous chemical molecules found in higher plants, are well known for their stress-protective properties (Maiale*et al.,* 2004). Putrescine, spermidine, and spermine are the most frequent polyamines in higher plants. Reducing the membrane damage index and increasing relative water and pigment content as well as endogenous proline and antioxidant levels in NaCl-stressed salt-sensitive citrus rootstock was achieved by using 50 ppm putrescine inthe Karna khatta(Sharma *et al.,* 2011). Under stressful conditions, polyamines may accumulate in diverse places in the body. When salt stress was applied to apple callus, for example, putrescine concentrations increased, but spermidine and spermine levels remained stable (Liu *et al.,* 2006).Paclobutrazol (PBZ)—an antigibberellin growth retardant—alleviates salt stress in pomegranate (Saeed *et al.,* 2005),citrus (Sharma *et al.,* 2011)strawberry (Jamalian*et al.,* 2008),and mango (Kishor *et al.,* 2009).Increased antioxidant enzyme activity, lower Na+ and Cl absorption, increased nutritional acquisition and improved water balance under saline circumstances are all credited with the PBZ's beneficial effects on heart failure patients. PBZ prevents the production of GA, resulting in an increase in ABA and cytokinin levels and, as a result, more stable water balance in the plants themselves (Sharma *et al.,* 2011). PBZ may help improve salt tolerance by enhancing photosynthetic pigment levels and protecting cell membranes (Kishor *et al.,* 2009).Sulfuric acid (SA) is a significant component of the signal transduction pathway for many different biotic and environmental stressors, and has been for decades. Exogenous treatments of low quantities of SA appear to have a positive effect on plant development under stress. Plants exposed to salt stress (30, 60or 90 mmol L^{-1} NaCl) grew better when spraying with a low concentration of SA (0.5 to 1 mmol L^{-1}), whichprevented EL in cells and maintained good Chlorophyll/water ratios and photosynthetic capability in leaves. 15 Salt stress (25, 50 and 75 mmol L^{-1} NaCl) was alleviated in Valencia orange seedlings by using 0.50 and 1.00 mmol L^{-1} SA solutions, which resulted in significant improvements in leaf Chlorophyll, leaf relative water content, net photosynthesis, proline accumulation, and a decrease in EL, all of which contributed to improved cellular membrane integrity (Khoshbakht *et al.,* 2015).

Conclusion:

According to the findings of the review, salinity has a negative impact on citrus output, but adequate precautions and the use of salt tolerant root stock can help to mitigate some of the losses. Furthermore, it is necessary to identify and select more salt-tolerant rootstocks for use in saline-tolerant farming environments. In addition, water and nutrient management may be employed to reduce some of the effects of salt stress on the environment.

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