

Battling the salt scourge: Keeping your ornamental blooms beautiful

Rising soil and water salinity pose a significant threat to ornamental plant cultivation by disrupting nutrient balance, inducing osmotic and oxidative stress, and reducing growth and flower quality. This article examines the detrimental impacts of neutral and alkaline salts and highlights natural plant adaptation mechanisms. It presents a comprehensive overview of mitigation strategies, including the selection of salt-tolerant varieties, improvement of soil structure with organic matter and amendments such as gypsum and biochar, efficient irrigation practices (drip systems), the use of salt-tolerant rootstocks, mulching, and optimized fertilizer management. The article also emphasizes the importance of salinity monitoring, gradual acclimatization, mycorrhizal associations, growth regulators, and anti-transpirants. By understanding these challenges and applying practical solutions, growers can protect the health and aesthetic value of ornamental plants in saline environments.

Keywords: Antioxidant, Nutrients, ROS, Salt stress, Sodium

ORNAMENTAL plants, often considered the jewels of our gardens and landscapes, typically require ample water. As freshwater becomes increasingly scarce, these plants face a hidden foe – salt. Whether from neutral salts like sodium chloride (NaCl) or alkaline salts such as sodium carbonate (Na₂CO₃), rising salinity in soil and irrigation water disrupts nutrient uptake, triggers stress responses, and diminishes the vibrancy of flowers.

Much like excessive salt disrupts human health, high salinity destabilizes plant physiological processes. Salt stress, caused by natural factors and human activities (over-irrigation, excessive fertilizer use, seawater intrusion), has become a major threat to plant growth, flowering, and overall landscape health.

Salinity levels in plants

Electrical conductivity (EC) is used to measure salinity. General classifications include:

- **Freshwater:** <0.6 dS/m
- **Slightly Brackish:** 0.6–1.5 dS/m
- **Brackish:** 1.5–3.0 dS/m
- **Moderately Saline:** 3–8 dS/m
- **Saline:** 8–15 dS/m
- **Highly Saline:** 15–45 dS/m

Salinity at 4 dS/m or above, especially due to sodium chloride, requires intervention.

Salty fallout: What happens to your plants?

Thirsty roots: Excess salt in the soil creates a high concentration of dissolved ions outside the plant roots.

This disrupts the natural water balance, causing water to move out of the roots instead of in. As a result, the plant experiences osmotic stress and becomes dehydrated. Over time, this stress can stunt growth and damage overall plant health.

Nutrient lockout: Too much sodium and chloride interfere with the uptake of vital potassium, a key player in regulating the plant's breathing pores (stomata). This hampers gas exchange and hinders photosynthesis, the plant's food-making process.

Internal chaos: When roots sense salt stress, they send chemical signals to the shoots as a defence response. These signals tell the plant to conserve energy by slowing down growth. However, this also disrupts the movement of vital nutrients like potassium and magnesium to the upper parts. As a result, the leaves and stems may show signs of deficiency and poor development.

Oxidative onslaught: Salt stress causes an imbalance in the plant's cellular environment, leading to the overproduction of reactive oxygen species (ROS). These highly reactive molecules act like 'cellular rust,' damaging proteins, lipids, and DNA. ROS weaken cell membranes, making them more permeable and less protective. This damage disrupts normal cellular functions and energy flow. If not controlled, oxidative stress can lead to cell death and poor plant health.

Spotting the trouble: Signs of salt stress

Plants will often send out SOS signals when under salt attack. Keep an eye out for:

Burnt edges: Tip burn or marginal leaf burn is a visible sign of salt stress, where the edges or tips of leaves turn brown or yellow. This happens because salt interferes with water uptake, leading to dehydration in those areas. The outer leaf tissues dry out first, showing damage before the inner parts. Over time, this can spread and affect the plant's ability to photosynthesize efficiently.



Marginal leaf burn symptom on *Spathiphyllum*

Bud blues: Salt stress disrupts the delicate balance of water and nutrients needed for bud development. This can cause buds to dry out, become damaged, or die before they bloom. As a result, flowering is often delayed or significantly reduced. The plant's growth cycle and reproductive success are negatively impacted.

Stunted growth: Under salt stress, plants struggle to absorb water and nutrients, which are essential for healthy growth. This leads to smaller, misshapen leaves and shortened stems. In severe cases, abnormal shoot branching occurs, forming dense clusters known as "witches' broom." These growth distortions weaken the plant and reduce its overall productivity.

Dieback: Dieback is a condition where the tips of twigs and stems begin to wither, dry out, and die. It often starts at the outer edges and progresses inward toward the main branches or trunk. This symptom usually indicates stress from disease, pests, root damage, or unfavourable environmental conditions. If left untreated, it can lead to the gradual decline and eventual death of the plant.

Increased wilting: Plants appear limp or droopy, often during the heat of the day. This can happen even if the soil feels moist, suggesting a problem with water uptake rather than water availability. Possible causes include root damage, disease, or poor soil aeration. Persistent wilting can weaken plants and reduce growth over time.

Flowering fizzle: Poor or delayed flower development often results in fewer or smaller blooms. Flowers may appear dull or lack their usual vibrancy, affecting overall plant appeal. This can be caused by nutrient deficiencies, stress, or inadequate light. It may also lead to reduced production in flowering crops.

Colour confusion: Leaves may change colour unexpectedly, often turning yellow or displaying unusual shades due to nutrient imbalances. These symptoms may include early leaf drop or the appearance of fall colours long before the season changes. Common causes include poor soil nutrition, root stress, or pH imbalances.

Thinning crowns: The upper parts of a plant or tree lose density, leaving sparse foliage mainly at the tips of branches. This condition often indicates long-term stress, such as root damage, pest infestation, or poor nutrition. The inner branches may become bare, giving the plant a



Yellowing of foliage in *Gazania*

weak, unhealthy appearance. If not addressed, it can lead to further decline or dieback.

Plant power: Natural defence mechanisms

Do not count your ornamentals out just yet! Plants have some clever ways to cope with salty conditions:

Ionic balance and osmotic savvy: Plants pump organic and inorganic solutes into their root cells to lower internal water potential, helping them absorb water despite saline surroundings. Proline acts as a protective molecule supporting osmotic balance and structural stability.

ROS scavengers: Salt-tolerant plants boost internal antioxidant systems using both enzymes (like SOD, CAT) and non-enzymatic compounds to neutralize those damaging ROS molecules.

Salt exporters: Plants that actively remove excess salt from their systems through specialized structures like glands or bladders. In species such as *Limonium* (sea-lavender), these glands excrete salt onto the leaf surface, where it can be washed away or crystallize. This adaptation helps them survive in salty environments like coastal areas or salt marshes. It is a key strategy for maintaining internal salt balance and avoiding toxicity.

Water misers: Succulents like *Portulaca* and *Aloe vera* can plump up their leaves to store more water and dilute the salt. Carnations, for example, reduce water loss through their leaves to better handle salinity.

Genetic guardians: Specific genes and proteins play crucial roles in the salt stress response, helping with ion balance (like SOS1),



Philodendron

sodium removal (like NHX1), potassium uptake (like HKT1), and regulating overall stress responses (through WRKY and NAC transcription factors).

TOOLKIT FOR TACKLING SALINITY: PRACTICAL STRATEGIES

Choose wisely: Salt-tolerant stars

Identifying which ornamental plants can tolerate saline conditions is the first line of defense. While some species, such as aster and African violet, are sensitive, others demonstrate greater resilience. Consider these options for salt-prone areas:

- **Moderately tolerant:** Chrysanthemum, carnation, stock
- **Relatively tolerant hydrangeas:** var. 'Ayesha,' 'Sabrina,' 'Selina'
- **Hardy shrubs:** *Bougainvillea*, *Hamelia patens*
- **Hardy trees:** Neem (*Azadirachta indica*), Date palm (*Phoenix dactylifera*), Norway maple, Russian-olive, Blue spruce, Austrian pine.



Aglaonema

Build better soil

Healthy soil is more resilient. Boost its structure and drainage by adding plenty of organic matter like compost. This improves water retention (counteracting the osmotic stress), nutrient availability and air circulation, preventing salt build-up around roots.

Amend with care

- **Gypsum power:** Calcium sulphate (gypsum) can help displace sodium ions in the soil, improving its structure and reducing the harmful effects of excess sodium. It's like a soil detoxifier!
- **Biochar boost:** This organic amendment improves the physical, chemical, and biological health of salty soils, increasing water-holding capacity and overall plant vigour.

Smart watering

- **Drip is king:** Opt for drip irrigation or soaker hoses to deliver water directly to the roots, minimizing salt build-up on leaves and efficiently leaching salts away from the root zone. Avoid sprinklers, which can splash salty water onto foliage, causing burns.
- **Water wisdom:** If you have the need to use saline water, consider pre-treating it through desalination or diluting it with freshwater if possible.

Strong foundations: Salt-tolerant rootstocks

Grafting your desired ornamental varieties onto salt-tolerant rootstocks (like *Rosa rubiginosa* or *Nerium oleander*) can significantly enhance their ability to withstand salty conditions.



Drip irrigation in hedge plants (*Duranta* and *Acalypha*)

Mulch magic

A layer of organic mulch around your plants helps conserve soil moisture, reduce evaporation (which can concentrate salts), and prevent salty water from splashing onto leaves during irrigation. Choose from options like cedar, pine bark, or compost.

Feed with finesse

Avoid high-salt fertilizers. Instead, go for low-salt or salt-free options like compost, well-rotted manure, worm castings, liquid seaweed extract, or fish emulsion. Slow-release and natural mineral fertilizers are also gentler on salty soils. When using liquid fertilizers, choose those with a lower NPK ratio.

Monitor your soil

It is essential to ensure optimal plant health, as high salt levels can hinder nutrient uptake and damage roots. Using a salinometer allows for accurate and timely testing of soil salinity, helping detect changes before they become problematic. Regular testing helps inform adjustments in irrigation, drainage, and fertilization practices. Proactively managing salinity can prevent long-term damage to crops and improve overall soil health.

Gradual adjustment

Slowly acclimating new plants to saline conditions, allowing them to adapt over time. Start by providing lower salt levels and gradually increase exposure as the

plant strengthens. This process minimizes stress, helping the plant build tolerance to salinity more effectively.

Mycorrhizal advantage

Inoculating your soil with beneficial mycorrhizal fungi can work wonders. These fungi extend their network in the soil, helping plants access more water and nutrients, improving their tolerance to salt stress, boosting their antioxidant defences, and even influencing plant hormones for better stress management.

Hormone help

Plant growth regulators (phytohormones) can be allies in the fight against salt stress. Abscisic acid (ABA) helps to conserve water, salicylic acid (SA) boosts antioxidant activity, jasmonic acid (JA) regulates stress responses, ethylene plays a role in ion transport, cytokinins aid in cell division under stress, and gibberellins (GA₃) can promote growth in some salt-stressed ornamentals.

Shield with sprays

Anti-transparent can form a protective layer on leaves, reducing water loss through transpiration, which is vital when dealing with osmotic stress caused by salinity. They can also offer some protection against salt burn.



Hibiscus plant

By understanding the challenges of salinity and implementing these practical strategies, you can help your ornamental flora not only survive but thrive, even in the face of increasing salt stress. Keep a watchful eye on your plants and your soil, and with a little proactive care, you can ensure your garden remains a vibrant and beautiful space.

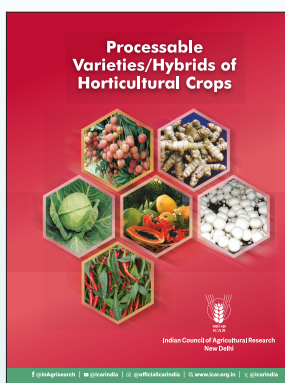
CONCLUSION

The increasing prevalence of soil and water salinity presents a significant challenge to the cultivation of ornamental plants, impacting their physiological processes, growth, and aesthetic value. However, by understanding the mechanisms of salt stress and the natural adaptive responses of plants, growers and gardeners can effectively mitigate these adverse effects. Implementing a combination of strategies, including the selection of tolerant varieties, soil management, efficient irrigation, and the judicious use of amendments and growth regulators, is crucial for maintaining healthy and vibrant ornamental displays in saline-prone environments. Continuous monitoring and a proactive approach will be key to ensuring the longevity and beauty of our cultivated landscapes in the face of this growing environmental concern.

For Further Information, Please Write To:

¹Division of Floriculture and Landscaping, ICAR-IARI, New Delhi; ²Division of Floriculture and Landscaping, ICAR-IIHR, Bengaluru; *Corresponding email: pnaikkt@gmail.com

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