Salinity Effect on Morphological Characteristic of Coriandrum Sativum L

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Abstract
Coriandrum sativum, commonly known as coriander, is a crucial herb valued for its culinary and medicinal uses. However, soil salinity presents a significant challenge to its cultivation, particularly in arid and semi-arid regions. High salinity levels adversely affect coriander's growth and productivity by altering its morphological characteristics and disrupting physiological processes. Salinity delays germination, reduces germination rates, and impairs seedling establishment. It also causes stunted growth and reduced biomass, leading to shorter plant height and diminished overall mass. Furthermore, salinity induces changes in leaf morphology, resulting in smaller, chlorotic leaves that hinder photosynthesis. The root system becomes shallower and less extensive, restricting water and nutrient absorption. These physiological disruptions include osmotic stress and ion toxicity, impairing vital metabolic functions. Coriander employs adaptive mechanisms to cope with these stresses, such as osmoregulation through compatible solutes and ion compartmentalization, along with enhanced antioxidant production to mitigate oxidative damage. Addressing these challenges involves developing salt-tolerant varieties and implementing effective management practices to ensure sustainable cultivation and optimal yield.

Keywords: Salinity Stress, Coriandrum sativum, Adaptive Mechanisms

I. Introduction

Coriandrum sativum, commonly known as coriander or cilantro, is a widely cultivated herb valued for its culinary and medicinal properties. Native to regions spanning from Southern Europe to Southwestern Asia, coriander is a staple in various cuisines and traditional medicine systems. However, like many crops, coriander is susceptible to environmental stressors, with soil salinity being one of the most significant challenges affecting its growth and productivity. Salinity, the presence of high concentrations of soluble salts in the soil, poses a substantial threat to agricultural productivity worldwide, particularly in arid and semi-arid regions where irrigation is necessary, and salt accumulation is prevalent. Soil salinity adversely affects plant growth and development by disrupting water uptake, ion balance, and metabolic processes. Coriander, though relatively adaptable, is not immune to the detrimental effects of salinity. Understanding how salinity impacts the morphological characteristics of coriander is crucial for developing effective cultivation strategies, especially in regions prone to salinity issues. This understanding is also essential for breeders aiming to develop salt-tolerant varieties and for farmers looking to implement management practices that mitigate the adverse effects of salinity on crop yield and quality. The morphological characteristics of coriander, such as germination rate, plant height, leaf size, root structure, and overall biomass, can be significantly altered under saline conditions[1]. High salinity levels can lead to delayed and reduced germination rates, stunted plant growth, smaller and chlorotic leaves, and a less extensive root system. These changes not only affect the plant's physical appearance but also its physiological functions, including water and nutrient uptake, photosynthesis, and overall resilience to environmental stresses. Several mechanisms are employed by

[1] **Bustamante et.al (2008).** Composts from distillery wastes as peat substitutes for transplant production. *Resources, Conservation and Recycling*, *52*(5), 792-799.

coriander plants to cope with salinity stress, including osmoregulation, ion compartmentalization, and antioxidant production. Osmoregulation involves the accumulation of compatible solutes like proline and glycine betaine, which help maintain cellular osmotic balance. Ion compartmentalization sequesters toxic ions such as sodium (Na+) and chloride (Cl-) into vacuoles, thereby reducing their harmful effects on cellular processes. The production of antioxidants helps mitigate oxidative stress caused by salinity. Addressing the salinity challenge requires a multifaceted approach, including soil amendments, improved irrigation practices, and the development of salt-tolerant coriander varieties. By understanding the specific impacts of salinity on coriander's morphological characteristics, researchers and farmers can better manage and mitigate these effects, ensuring sustainable cultivation and optimal yield of this valuable herb. This review aims to comprehensively examine the morphological responses of Coriandrum sativum to salinity stress, highlighting key findings and practical implications for agricultural practice[2].

II. Review OF Literature

Bustamante et al (2008). It was investigated if composts made from distillery wastes may be used as substitute growth medium materials for transplant production rather than peat, the collection of which causes significant environmental harm. Two composts were made using leftover grape marc and manure from cattle (C1) and leftover grape marc and manure from fowl (C2). Grown were four vegetable species: coriander (Coriandrum sativum), broccoli (Brassica oleracea), chard (Beta vulgaris) and lettuce (Lactuca sativa). Nine substrates were compared: six combinations with 25%, 50%, and 75% by volume of each compost with the appropriate peat acting as diluent; limed white peat (control); compost C1; compost C2; and six other composts. The study examined the germination process and its impact on the nutritional and morphological characteristics of transplants using various peat/compost combinations. When compared to peat, all of the elaborated media demonstrated sufficient physical, physico-chemical, and chemical qualities for their use as growing media in horticulture. These two composts are therefore suitable ingredients for partial peat substitution, in amounts of 25–50% by volume, without compromising yield or nutritional status results.

Nadjafi et al (2009). An investigation of the irrigation termination at various phenological phases in several land races of coriander was carried out. Four Iranian land races (Hamadan, Khuzestan, Shiraz, and Yazd) and three irrigation treatments (I1: irrigation terminated at the start of blooming, I2: irrigation discontinued at the start of flowering, and I3: irrigation ended at the start of seed development) were examined. The yield components are not much affected by irrigation regimes; nevertheless, I3 showed the maximum seed yield. In coriander seeds, a water shortage dramatically raised the proportion of essential oils and the concentration of linalool, but it also reduced the yield of essential oils (g.m-2). Plant height, the number of umbellets per umbel, and the weight of seeds per plant did not vary considerably; however, the Hamadan land race has a much greater number of branches and umbels per plant. There were no appreciable variations in seed yield amongst the land races. There was a clear disparity in the primary constituents of essential oils across the various land races. Although the Yazd land race was found to have the greatest essential oil content, the Khuzestan land race had the highest linalool concentration in its seeds. Shiraz land race was also found to have the greatest concentration of pentadecanone in its vegetative tissues. The land races' essential oil yields did not very much. There was no discernible interaction impact between land races and irrigation regimes.

Farahani et al (2009). In nations whose agricultural production is mostly dependent on rainfall, drought stress is particularly significant. An increase in solute concentration in the environment brought on by drought stress results in the osmotic flow of water out of plant cells. Plant cells then experience a rise in solute concentration, which lowers water potential, damages membranes, and interferes with vital functions like photosynthesis. As a result, the drought-stressed plants show low production and growth. In the worst situation, the plants perish. Some plants have evolved defence systems to withstand low water levels. These defence mechanisms

[2] **Nadjafi et.al., (2009).** Effect of irrigation regimes on yield, yield components, content and composition of the essential oil of four Iranian land races of coriander (Coriandrum sativum). *Journal of Essential Oil Bearing Plants*, *12*(3), 300-309.

are categorised as escape, avoidance, or tolerance. Additionally, for thousands of years, aromatic and medicinal plants have been a vital part of our everyday existence. Aromatic and therapeutic plants may be seen in several cave paintings. Even now, research shows how important it is to protect our environment while uncovering new health advantages associated with plants. In order to manage and use water properly in medicinal and aromatic plant farming during drought conditions, as well as to increase the quantity and quality characteristics of medicinal and aromatic plants in arid and semi-arid areas, this review may provide useful advice to commercial farmers and researchers studying medicinal and aromatic plants.

Ben et al (2011). Given that soil salinity is a common issue, we suggested concentrating on how it affects the development of seedlings, the mineral content of the soil, and in particular, the composition of essential oils that are known to be dependable in abiotic circumstances. Hydroponically grown clary sage seedlings were grown at varying salinity levels (0, 25, 50, and 75 mM NaCl). It was established what the dry biomass and mineral element contents were. GC and GC-MS were used to extract and analyses the essential oils. The growth was found to be 42% slower at 75 mM. Together with an increase in Na+ levels, there was also a modest limitation in K+ absorption, a reduction in tissue hydration, and a decrease in growth. In terms of essential oil yields, the application of 25 mM NaCl greatly enhanced the production, which declined as the concentration of salt rose. Furthermore, as each salt concentration seemed to create a distinct new chemotype in clary sage essential oil, it was discovered that salt treatment also had a significant impact on the chemical makeup of clary sage.

Perveen et al (2011). Low power continuous wave He-Ne laser irradiation at energies of 0, 100, 300, and 500 mJ was applied to water-soaked sunflower seeds in order to assess the impact on several biochemical, physiological, growth, and yield characteristics of the plant. The complete randomised design (CRD) studies, including four repetitions, were conducted in a greenhouse environment. The seeds treated with He-Ne showed significant increases in physiological attributes such as photosynthetic rate (A), transpiration rate (E), intrinsic CO2 concentration (Ci), stomatal conductance (gs), contents of chlorophyll a and b, relative membrane permeability and leaf water (ψw), osmotic (ψs) and turgor (ψp) potentials, relative water contents, and leaf area when compared to the control. The laser treatment also resulted in an increase in the contents of total soluble proteins, malondialdehyde, proline, and leaf total phenolic as well as the activities of catalases, superoxide dismutase, and peroxidase. Significant increases in the number of leaves per plant, shoot fresh and dry masses, root fresh and dry masses, root and shoot lengths, and stem diameter have also been noted in sunflower growth metrics. The laser treatment resulted in an overall rise of up to 28.12%% in the levels of K, Ca, and Mg in the shoot and root.

Al-Saadi et al (2012). The purpose of this study was to determine how salt levels and growth regulators (Ethephon and Kinetin) affected the germination of Coriandrum sativum, Lactuca sativa, and Raphanus sativus seeds. It was carried out at the College of Science, Basrah University in 2010.Salinity levels (NaCl) of 0.0, 2.5, 5, and 10 ds/m were used to grow the plants. The seeds were immersed in a solution containing ethephon (50, 75, and 100 ppm) and kinetin (1, 5 and 10) ppm, with distilled water serving as the control. As salinity rose to a level of 10 ds/m, the findings demonstrated a considerable reduction in seed germination. The findings showed that higher saline levels lowered seed vigour features as determined by the mean germination time and seed germination index, in addition to decreasing seed germination. When compared to the control treatment, the fresh and dry weight of the seedling decreased dramatically as the salt level rose up to 10 ds/m. When compared to distilled water, soaking seeds in ethephon or kinetin enhanced seed germination and seed and seedling vigour under salt levels. The highest level of seed germination was achieved by immersing seeds in a solution containing 10 ppm of kenethin and 100 ppm of ethephon.The findings demonstrated that treating seedlings with ethephon at 100 ppm and kinetin at 10 ppm significantly increased their fresh and dried weights. Seed germination under salinisation was enhanced by Ethephon 75 ppm and Kinetin 10 ppm by up to 10 ds/m. Raphanus sativus seed germination increased significantly by 80% when treated with ethephon at salinities of 100 ppm and 10 ds/m. In Coriandrum sativum, kinetol was 90% at 10 ppm and 5 ds/m salinity.

Setayesh Mehr, Z., & Esmaeizadeh Bahabadi, S. (2013). Two tests were carried out during the germination and vegetative phases to see how the medicinal coriander plant responded to salt stress. This research was conducted as a factorial experiment with three replications using a totally randomised design. Five different salinity concentrations—0, 25, 50, 75, and 100 mM NaCl—were used as treatments. Evaluations were conducted on the germination response of coriander seeds in the first experiment and the physiological traits in the second experiment. The findings indicated that a rise in salinity considerably reduced the parameters of germination, such as the percentage and rate of germination, the length of the radicle and plumule, and the dry weight ($p \leq 0.01$). Morphological characteristics such as leaf count, shoot and root length, and fresh and dry weight in the shoot and root all reduced as salt increased. Significant ($p \leq 0.01$) effects of salt stress were seen in the amounts of soluble carbohydrates, phenolic compounds, proline, and chlorophyll. The average comparison of treatments shown that although the content of chlorophyll in leaves declined, proline, carbohydrates, and phenolic compounds rose in shoot and root with increasing salt stress. The hypothesis that proline accumulation, soluble carbs, and phenolic chemicals are linked to plant resistance to salt stress is supported by our findings.

Nazeruddin et.al., (2014). It has previously been successfully accomplished to synthesise metal nanoparticles extracellularly in situ utilising plant extracts such as Zingiber officinale (ginger) and Azadirachta indica (neem). In this work, we have created a brand-new technique for producing silver nanoparticles via a biochemical interaction between a silver salt solution and Coriandrum sativum seed extract, all without the need of surfactants or outside energy. Ag nanoparticles (NPs) that are biocompatible and physiologically stable were produced using this technique. With their functionalised state, these AgNPs may find use in targeted drug delivery, offering improved therapeutic effectiveness and reduced adverse effects. It is well known that adding some plant extracts to a metallic salt solution causes a quick reduction that creates very stable metal nanoparticles. The production of nanoparticles was accelerated by this approach, resulting in a reaction time of 1-2 hours, as opposed to the 2-4 days that microorganisms needed. These nanoparticles' shape and chemical makeup were examined using a variety of characterisation methods. The development of spherical, non-uniform, polydispersed nanoparticles with a mean size of 13.09 nm was shown by the TEM picture of these NPs. A thorough investigation of the antimicrobial properties of nanoparticles and their ability to work in concert with popular narrow-spectrum antibiotics has been completed with success.

Nirmal Babu et al (2015). Spice conservation, utilisation, and production can be greatly enhanced by the application of biotechnological techniques such as micropropagation, somaclonal variation, in vitro conservation, synseed technology, protoplast fusion, flavour and colouring component production, and the creation of novel transgenics. Many spices have effective micropropagation systems that are employed for crop improvement via somaclonal variety and transgenic routes, propagation, conservation, safe transit and sharing of germplasm, and so on. Researchers are attempting to produce metabolites, flavourings, and colourings from immobilised and altered cell cultures. For the purposes of crop profiling, fingerprinting, duplication identification, and marker-assisted breeding, molecular markers and maps are being created. A growing number of valuable genes are being identified, isolated, and cloned using transcriptome sequencing. For the purpose of managing crop health in spice crops, biotechnological methods using microbials (antogonists/hyperparasites and PGPRs) with a wide range of disease suppression and growth promotion have been proven to be successful.

Massoud et al (2016). In order to investigate the effects of sowing dates (September, October, November, December, and January) and the foliar application of certain natural stimulants (Seaweeds extract, Moringa leaf extract, Salicylic acid, and Chitosan) as well as their interactions on vegetative growth, fruit yield, and essential oil of the coriander (Coriandrum sativum L.) plant, the present study was conducted at El-Baramoon Experimental Farm, Hort. Res. Institute, Agric. Res. Centre, Ministry of Agric. The findings demonstrated that, when compared to alternative planting dates in both seasons, sowing coriander seeds in October produced a significant improvement in growth characteristics, fruit production, and essential oil composition.

Comparing foliar applications of various natural stimulants (seaweed extract and control plant) to those of moringa leaf extract and salicylic acid, they showed substantial effects on all examined parameters. Furthermore, the results of the interaction treatments showed that plants grown in October and treated with chitosan had the greatest mean values for the majority of growth features, fruit yield, and essential oil output. Good output at cold temperatures was obtained by delaying seeding until December and January and then spraying with Moringa leaf extract. The essential oil's G.L.C. identified a total of eleven components. Linalool was the primary chemical, accounting for 79.8% of the sowing date in October when chitosan was applied topically, and 78.3% in January when moringa leaf extract was applied topically.These findings shown that coriander plants may be grown in a variety of climates with the use of natural stimulants. Spraying plants with chitosan foliar application under early and regular sowing dates might boost fruit output and active ingredients; under delayed sowing dates, plants could be sprayed with moringa leaf extract.

Aytah et al (2017). The purpose of the current investigation was to find out if raising the sulphur concentrations in irrigation water may lessen the harmful effects of chromium poisoning. For six weeks, until full growth and healthy development, the grown coriander seeds were treated with varying amounts of sulphate (0.4, 0.8, and 1.6 mM magnesium sulphate). In order to manage treatment concentrations of 0 µM, 50 µM, and 100 µM chromium, each treated group was split into three subgroups. Measurings included stem and root lengths, fresh and dried weights, colours, protein content, and chromium concentration. The results demonstrated that the observed morphological and physiological parameters significantly decreased as chromium concentrations increased. Furthermore, when the quantity of chromium in irrigation water increased, chromium accumulated in coriander plants. Sulphur content increases lead to longer shoot and root lengths as well as higher dry weights, which mitigate the negative effects of chromium. Sulphur also raised the pigment content in plants treated with chromium to levels comparable to control plants. Sulphur had a greater impact at 50 µM Cr than at 100 µM Cr. Both of the sulphur concentrations worked well.

Rosales et al (2018). The magnetic influence of an electric current or magnetic substance is known as a magnetic field (MF), and its magnitude may be expressed in Tesla (T) or Gauss. Scientists discovered that magnets may affect plant growth in the sixteenth century. Subsequent research has been done, and the findings have shown that varying MF intensities have caused distinct morphological and genetic traits in many plant species. While some experience growth regression, others see notable growth. Therefore, the primary goal of this research was to ascertain how the MFs from ceramic and neodymium magnets affected the rate of coriander seed germination and growth. In this experiment, three (3) centimetres was the distance between the seeds and the magnets. Both ceramic and neodymium magnets produced three distinct magnetic fields. Additionally, the polarity was examined, with some seeds being exposed to the north pole pointing upward and others to the south pole. The studies' findings demonstrated that the germination and growth rate of coriander are affected by the kind of magnets used, the intensity of the magnetic field, and the polarity. When compared to the control, which consisted of seeds planted in an area where just the Earth's geomagnetic field (GMF) was present and all plants grew, the impact was substantial. According to this study, neodymium magnets outperformed ceramic magnets in terms of their ability to accelerate growth. Additionally, research demonstrated that, in comparison to the other treatments, the low and medium strengths neodymium magnets with the south pole pointed upwards provided the greatest growth.

III. Impact on Germination and Seedling Growth

- **Delayed Germination:** High soil salinity levels can significantly delay the germination process in coriander seeds, extending the time required for seeds to sprout and establish seedlings.
- **Reduced Germination Rates:** Salinity stress often leads to a decrease in the overall germination rate, resulting in fewer seeds successfully sprouting and contributing to lower crop establishment.

- **Poor Seedling Establishment:** Increased salinity can cause weak and uneven seedling growth, affecting the uniformity of crop stands and potentially reducing the overall productivity and health of the coriander plants[3].

IV. Effect on Plant Height and Biomass

High salinity levels have a detrimental impact on the growth and biomass of Coriandrum sativum, commonly known as coriander. Under saline conditions, coriander plants often exhibit stunted growth, resulting in a shorter stature compared to those grown in non-saline environments. This reduction in plant height is primarily due to the osmotic stress caused by high salt concentrations, which hampers the plant's ability to absorb water efficiently. Additionally, the ionic toxicity from excessive sodium (Na+) and chloride (Cl-) ions disrupts vital cellular functions and metabolic processes, further inhibiting growth.

The overall biomass of coriander plants is also significantly reduced under saline conditions. This reduction is observed in both the shoot and root systems, leading to a diminished total mass of the plant. Lower biomass means fewer leaves and a less extensive root system, which adversely affects the plant's ability to perform photosynthesis and uptake essential nutrients. Consequently, the yield of coriander is greatly impacted, with fewer and smaller leaves being produced, thereby lowering the quality and quantity of the harvest. These effects not only reduce the market value of the crop but also undermine the plant's resilience to other environmental stresses. Understanding and mitigating the impacts of salinity on coriander is crucial for maintaining its productivity and quality in affected regions[4].

V. Changes in Leaf Morphology

Salinity stress significantly alters the leaf morphology of Coriandrum sativum, leading to smaller, narrower leaves and the development of chlorosis, a condition characterized by yellowing of the leaves. These morphological changes are detrimental to the plant's overall health and productivity. Chlorosis occurs due to nutrient imbalances and the toxic accumulation of sodium (Na+) and chloride (Cl-) ions, which disrupt the normal functioning of chlorophyll and impair photosynthesis. Smaller leaf size reduces the photosynthetic surface area, thereby decreasing the plant’s ability to capture light and produce energy. This limitation in photosynthetic capacity directly affects the plant's growth, development, and resilience. Additionally, the smaller and chlorotic leaves have reduced efficiency in gas exchange and transpiration, further impairing the plant's metabolic activities and water use efficiency. As a result, the overall vigor of the plant declines, making it more susceptible to additional stresses and reducing its potential yield. Understanding these changes in leaf morphology under salinity stress is essential for developing effective strategies to enhance coriander's tolerance to saline conditions and ensure sustainable cultivation in affected regions.

VI. Alterations in Root Structure

Elevated salinity levels significantly impact the root structure of Coriandrum sativum, leading to a shallower and less extensive root system. This compromised root architecture restricts the plant's ability to penetrate deeper soil layers, limiting access to vital water reserves and nutrients. As a result, the plant experiences increased difficulty in sustaining adequate hydration and nutrient uptake, which are crucial for healthy growth and development. The reduced root system also means less surface area for absorption, exacerbating the plant’s struggles under saline conditions. Consequently, the overall health of the plant deteriorates, manifesting in stunted growth and decreased biomass.

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[3] **Farahani et.al., (2009).** Medicinal and aromatic plants farming under drought conditions. *Journal of Horticulture and Forestry*, *1*(6), 086-092.

[4] **Ben Taarit et.al., (2011).** Physiological changes and essential oil composition of clary sage (Salvia sclarea L.) rosette leaves as affected by salinity. *Acta physiologiae plantarum*, *33*(1), 153-162.

The impaired root structure under saline stress also has broader implications for the plant's physiological functions. With a less extensive root network, the plant's stability and anchorage in the soil are compromised, making it more susceptible to environmental stresses such as drought and wind. Additionally, the inefficient nutrient uptake due to the shallow roots leads to deficiencies in essential minerals, further hindering the plant's metabolic processes and overall vitality. This situation creates a negative feedback loop, where the plant's weakened state under salinity stress exacerbates its inability to cope with other environmental challenges, ultimately impacting the yield and quality of the coriander crop. Understanding these alterations in root structure is crucial for developing effective strategies to enhance coriander's resilience to salinity and ensure sustainable agricultural practices[5].

VII. Physiological and Metabolic Disruptions

Salinity disrupts Coriandrum sativum's physiological and metabolic processes by interfering with water uptake and ion balance, leading to osmotic stress and ion toxicity. High salt concentrations create an osmotic gradient that hinders the plant's ability to absorb water efficiently, causing dehydration at the cellular level. The excessive accumulation of sodium (Na^+) and chloride (Cl^-) ions disrupts the ionic balance within plant cells, impairing essential functions such as enzyme activity, nutrient transport, and photosynthesis. This ionic imbalance results in toxicity that damages cellular structures and metabolic pathways, further compromising the plant's growth and development. Consequently, the overall physiological functions of coriander, including water use efficiency, nutrient assimilation, and energy production, are significantly impaired, reducing the plant's resilience to environmental stresses and leading to diminished health and productivity. Understanding these physiological and metabolic disruptions is vital for developing strategies to enhance coriander's tolerance to saline conditions and ensure sustainable cultivation[6].

7.1 Adaptive Mechanisms

- **Osmoregulation and Ion Compartmentalization:** To manage salinity stress, coriander plants utilize osmoregulation by accumulating compatible solutes such as proline and glycine betaine. These solutes help maintain cellular osmotic balance and protect against dehydration. Additionally, coriander employs ion compartmentalization, sequestering toxic sodium (Na^+) and chloride (Cl^-) ions into vacuoles to minimize their harmful effects on cellular processes and ensure proper ion balance.
- **Enhanced Antioxidant Production:** Coriander responds to salinity-induced oxidative stress by increasing the production of antioxidants. These compounds, including enzymes like superoxide dismutase (SOD) and catalase, help neutralize reactive oxygen species (ROS) generated under saline conditions. This enhanced antioxidant defense mechanism mitigates oxidative damage to cellular components, supporting the plant's overall stress resilience and maintaining its metabolic functions.

VIII. Conclusion

Salinity significantly impacts the growth and productivity of Coriandrum sativum by affecting its morphological and physiological characteristics. High salinity levels lead to delayed germination, stunted growth, reduced biomass, and altered leaf morphology, all of which compromise the plant's overall health and yield. The root structure is also adversely affected, reducing the plant's ability to absorb essential nutrients and water. These disruptions are compounded by physiological and metabolic impairments caused by osmotic stress and ion toxicity. However, coriander exhibits adaptive mechanisms such as osmoregulation, ion compartmentalization, and enhanced antioxidant production to mitigate these effects. Effective management strategies, including the development of salt-tolerant varieties and improved agricultural practices, are

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[5]**Perveen et.al.,(2011).** He-Ne laser-induced improvement in biochemical, physiological, growth and yield characteristics in sunflower (Helianthus annuus L.). *Photochemistry and photobiology*, *87*(6), 1453-1463.

[6] **Al-Saadi et.al., (2012).** Effect of some growth regulators on seed germination of some plants grown under different levels of salinity. *journal of the college of basic education*, *18*(74), 109-124.

essential for maintaining coriander cultivation in saline-affected areas. Understanding and addressing the specific impacts of salinity on coriander is crucial for ensuring sustainable agriculture and optimizing crop yield and quality.

References

1. **Bustamante, M. A., Paredes, C., Moral, R., Agulló, E., Pérez-Murcia, M. D., & Abad, M. (2008).** Composts from distillery wastes as peat substitutes for transplant production. *Resources, Conservation and Recycling*, *52*(5), 792-799.
2. **Nadjafi, F., Damghani, A. M., & Ebrahimi, S. N. (2009).** Effect of irrigation regimes on yield, yield components, content and composition of the essential oil of four Iranian land races of coriander (Coriandrum sativum). *Journal of Essential Oil Bearing Plants*, *12*(3), 300-309.
3. **Farahani, H. A., Valadabadi, S. A., Daneshian, J., Shiranirad, A. H., & Khalvati, M. A. (2009).** Medicinal and aromatic plants farming under drought conditions. *Journal of Horticulture and Forestry*, *1*(6), 086-092.
4. **Ben Taarit, M., Msaada, K., Hosni, K., & Marzouk, B. (2011).** Physiological changes and essential oil composition of clary sage (Salvia sclarea L.) rosette leaves as affected by salinity. *Acta physiologiae plantarum*, *33*(1), 153-162.
5. **Perveen, R., Jamil, Y., Ashraf, M., Ali, Q., Iqbal, M., & Ahmad, M. R. (2011).** He-Ne laser-induced improvement in biochemical, physiological, growth and yield characteristics in sunflower (Helianthus annuus L.). *Photochemistry and photobiology*, *87*(6), 1453-1463.
6. **Al-Saadi, S. A. A., & A'lla, N. H. (2012).** Effect of some growth regulators on seed germination of some plants grown under different levels of salinity. *journal of the college of basic education*, *18*(74), 109-124.
7. **Setayesh Mehr, Z., & Esmaeizadeh Bahabadi, S. (2013).** effect of salt stress on some phological and biochemical characteristics in Coriandrum sativum L. *Journal of Plant Production Research*, *20*(3), 111-128.
8. **Nazeruddin, G. M., Prasad, N. R., Prasad, S. R., Shaikh, Y. I., Waghmare, S. R., & Adhyapak, P. (2014).** Coriandrum sativum seed extract assisted in situ green synthesis of silver nanoparticle and its anti-microbial activity. *Industrial Crops and Products*, *60*, 212-216.
9. **Nirmal Babu, K., Divakaran, M., Raj, R. P., Anupama, K., Peter, K. V., & Sarma, Y. R. (2015).** Biotechnological approaches in improvement of spices: a review. *Plant Biology and Biotechnology: Volume II: Plant Genomics and Biotechnology*, 487-516.
10. **Massoud, H. Y., Abdelkader, H. H., El-Ghadban, E. A., & Mohammed, R. M. (2016).** Improving Growth and Active Constituents of (Coriandrum sativum l.) Plant Using Some Natural Stimulants Under Different Climate Conditions. *Journal of Plant Production*, *7*(6), 659-669.
11. **Aytah, A. A., Kader, D. Z. E. A., & lafi Elharbi, F. (2017).** EFFECT OF INCREASED SULFUR CONCENTRATION ON THE PHYSIOLOGICAL AND MORPHOLOGICAL RESPONSES OF THE CORIANDER (CORIANDRUM SATIVUM) PLANT TO CHROMIUM TOXICITY. *British Journal of Environmental Sciences*, *5*(2), 31-50.
12. **Rosales, S., Daniels, D., & Tzib, L. (2018).** The Effects of Neodymium and Ceramic Magnets on the Germination and Growth Rate of Coriander (Coriandrum sativum) in Ex-vitro Conditions. *Int J Adv Sci Res Eng*, *4*(9), 17-22.