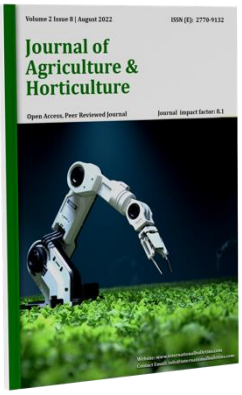

BIOLOGY OF MEDICINAL PLANTS BEING INTRODUCED IN SALINE LANDS

Sullieva Suluv Khurramovna
Botany department, Termez State University, 190100 Termez, Uzbekistan
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Abstract: Medicinal plants have long been a crucial component of traditional healthcare systems, providing natural remedies and therapeutic agents for a wide range of ailments. As the global population continues to grow, the demand for these natural resources has escalated, leading to the exploration of new and diverse habitats for the cultivation and extraction of valuable medicinal compounds. One such area of interest is the introduction of medicinal plants into saline lands, which presents both challenges and opportunities for the scientific community. Saline lands, characterized by high concentrations of soluble salts in the soil, pose a unique set of environmental stressors that can significantly impact the growth and development of plants. These conditions, including elevated levels of sodium, chloride, and other salts, can lead to osmotic stress, ionic toxicity, and nutrient imbalances, ultimately hindering the ability of many plant species to thrive. However, certain medicinal plants have evolved adaptations that enable them to withstand and even flourish in these harsh conditions, making them valuable candidates for cultivation in saline environments. In this article, we will provide some information about living plants in saline lands.

Keywords: plants, climate change, different conditions, quality of water, statistics, places

Introduction: The world is thriving with human population which continues to encroach the rural landscapes and in doing so chemical waste and byproducts of industrial and technological development continue to contaminate the soil and water resources. According to a report on WHO in the water quality and health strategy for 2001-2005, half of the world's population is currently living in areas where they cannot be certain of the quality of water resources and 38% of the burden of disease is related to the issues of water resources and sanitation. This is an indirect burden on our society which continues to degrade and deplete the natural resources that are vital as a protection and cure mechanism for the various diseases that are suffered. This is where medicinal plants establish their importance. As mentioned by Parry in his paper "Plants provide humans with a healthier and more environmentally friendly existence" (2000). However, with the land degradation and shortage of water resources, these medicinal plants are becoming more difficult to cultivate and maintain. In various countries, there are vast areas of abandoned agriculture land and dried up pastures. This land, which is usually rich in mineral resources, becomes saline and sodic in nature (Rangaswami, 2002).

Looking to the nature ab initio, there have always been healthy life surroundings with human beings receiving the medicine free of cost. There are however very few people who understand the importance of that medicine in comparison to today's environment where

pharmaceutical manufactured drugs are considered to be the better option to medicine. Medicinal plants have been used throughout the human history to cure illness and diseases. Today due to the advancement in medicinal science, these plants are less considered for cure. Medication like aspirin is now medically produced but the existence of these plants is vital. This is because we cannot be certain when these synthetic drugs may no longer be available (Ghani, 2002).

Importance of Medicinal Plants

Medicinal plants are part and parcel of human society to combat diseases from time immemorial. Indigent people rely on traditional medicine, food and fodder for their well-being and in most cases their survival depends on these natural resources. Tribal and folklore herbal medicine is still popular in many countries including Australia, Africa, South America, China, India and Africa. Nearly 80% of the world's population depends on traditional medicine, mainly plant-based, for their primary health care. Medicinal plants are a source of important therapeutic aids for alleviating human and animal diseases. It is estimated that one third of all the higher plants are medicinally important and in danger of extinction within a decade, and the loss of many species is a loss of potential resources of new drug substances.

Medicinal plants have always been an important strategy in treating diseases. The WHO notes that of the 21,000 plant species used for medicine, only 250 have been thoroughly studied. The current drugs available are derived from only 121 plant species. This makes it crucial that plant medication continues to be an area of focus in order to supplement or find alternatives to current pharmaceuticals. At a cost of $27 billion, pharmaceutical companies acquire one new drug approval. Can you imagine how expensive it would be to find a drug compound in a plant, extract it, and then replicate it synthetically? Not only would cost be significantly reduced, but there is a higher chance of finding a drug compound more effective than the current one. With limitless species of plants, the potential medication is incomprehensible.

Saline Lands and their Challenges

Saline soil, although consisting largely of rock and other insoluble material, provides an inadequate medium for most plants because of its content of harmful salts. The most usual cause of increased salt concentration in soils is a disproportion between the amount of water added and the amount lost by percolation or evaporation. Salinity is a major abiotic stress that affects the growth and yield of most crop plants. More than 800 million hectares of the world's total land area have been estimated to be salty, and experts believe there is a great potential in increasing this area. Over the last century, many countries with expanding populations have been reclaiming inland and marginal sea areas for food production. This process, in England known as enclosure, involved draining off the excess water, which often shoved the upper salt layers down and the removed water forced the salt into the remaining soil. Such soil would eventually degrade with the development of salt marsh and later by further desiccation, leaving a barren saline area. An example of saline land destruction through human mismanagement exists within the Australian wheat belt. This is estimated to affect 2-3% of the agricultural land in developed countries, although salt is a problem in both developed and underdeveloped countries. This may not seem significant, but it is the rapid rate of saline land expansion and the potential of further degradation that has placed a high priority on the need to find a solution for salt-affected soils.

Objectives of the Study

Keeping in view the reported anti-infective and anti-cancer potential in the crude extracts of some halophytes, present work has been designed to explore the medicinal potential in halophytes growing in saline areas.

The main objectives were to find out, collect and document the information on medicinal flora growing in saline habitats and to evaluate the ethnopharmacological reports about the usage of halophytes for various human and veterinary ailments.

An extensive search was carried out to identify the medicinal flora growing in saline areas. The precise information was collected from various books, research articles and from the persons involved in traditional herbal medicine. The reports on the usage of some halophytes for medicinal purpose were generally scattered and were not the primary focus of the articles. However, an attempt was made to locate the plants and their specific medicinal uses. The information thus collected was compiled, structured and documented. A sizable data is gathered but it is most likely that there are still many plants which missed our literature search. The documentation of medicinal uses of halophytes is an ongoing process and the present compilation will certainly provide a sound foundation for the future studies on medicinal flora growing in saline lands.

The ability of medicinal plants to flourish in saline lands can be attributed to a complex interplay of physiological, biochemical, and morphological adaptations. At the physiological level, these plants have developed intricate mechanisms to regulate the uptake and distribution of essential nutrients and water, even in the face of high salinity. Through the selective exclusion or compartmentalization of sodium and chloride ions, they are able to maintain a delicate balance within their cells, ensuring the optimal functioning of vital processes.

Accompanying these physiological adaptations are a suite of biochemical responses that further enhance the plants' resilience. The production of compatible solutes, such as proline, glycerol, and betaine, serves to maintain cellular osmotic balance, protecting the plant's internal structures from the dehydrating effects of high salinity. Additionally, the synthesis of antioxidant compounds, including flavonoids and carotenoids, helps to mitigate the oxidative stress induced by the saline environment, preserving the integrity of cellular membranes and biomolecules.

At the morphological level, medicinal plants have evolved a remarkable array of adaptations to thrive in saline lands. The development of succulent, waxy, or hairy leaves and stems helps to reduce water loss and minimize the absorption of harmful ions. Some species have even adapted their root systems, with the formation of specialized structures that can selectively exclude or excrete excess salts, further enhancing their ability to survive and flourish in these challenging environments.

The significance of these adaptation mechanisms extends far beyond the realm of botanical science. Medicinal plants, with their inherent resilience and unique chemical profiles, have long been recognized for their immense therapeutic potential. By understanding the intricate ways in which these plants adapt to saline lands, researchers and pharmaceutical companies can unlock new avenues for the development of novel, effective, and sustainable medicinal treatments.

Moreover, the study of medicinal plant adaptations in saline lands holds profound implications for the broader field of environmental conservation. As climate change and human activities continue to exacerbate the salinization of soils and water sources worldwide,

the preservation and cultivation of these resilient species become increasingly crucial. By safeguarding the habitats and genetic diversity of medicinal plants, we not only ensure the availability of valuable natural resources but also contribute to the overall ecological balance and resilience of these fragile ecosystems.

The biology of medicinal plants introduced to saline lands is a complex and multifaceted field of study. Researchers have delved into the physiological mechanisms that allow these plants to cope with the stresses of saline environments, examining factors such as ion homeostasis, osmotic adjustment, and the production of secondary metabolites. Understanding these adaptive strategies is crucial for developing effective cultivation and management practices that can maximize the yield and quality of the desired medicinal compounds.

One of the key areas of focus in the biology of medicinal plants in saline lands is the role of halophytes, or salt-tolerant plants, which have evolved unique mechanisms to thrive in high-salinity environments. These plants often exhibit enhanced production of antioxidants, compatible solutes, and other stress-responsive compounds, which not only contribute to their survival but also enhance the medicinal properties of the plants. Exploring the genetic and biochemical basis of these adaptations can provide valuable insights for the development of salt-tolerant cultivars and the optimization of medicinal plant production in saline lands.

In addition to the physiological adaptations of medicinal plants, the introduction of these species into saline environments also raises important ecological considerations. The integration of medicinal plants into saline ecosystems can have far-reaching impacts on the local flora and fauna, potentially altering community dynamics, nutrient cycling, and ecosystem services. Careful assessment of the environmental impacts, as well as the development of sustainable cultivation practices, is essential to ensure the long-term viability and conservation of these valuable medicinal resources.

Furthermore, the cultivation of medicinal plants in saline lands presents unique challenges in terms of soil management, irrigation, and the mitigation of salinization. Researchers are exploring innovative strategies, such as the use of halophytic companion plants, the application of soil amendments, and the implementation of precision irrigation techniques, to address these challenges and optimize the productivity and sustainability of medicinal plant cultivation in saline environments.

Salt Tolerance Mechanisms

Medicinal plants that tolerate saline conditions employ various physiological and biochemical adaptations to cope with the osmotic stress and ionic toxicity associated with high salt levels. These mechanisms include:

- Ion Exclusion: Plants restrict the uptake of excess salt ions into their tissues by regulating ion transport across cell membranes.

- Ion Compartmentalization: Salt ions are sequestered into specialized vacuoles or other cellular compartments, preventing their accumulation in sensitive metabolic processes.

- Osmolyte Accumulation: Plants accumulate compatible solutes, such as proline, glycine betaine, and sugars, which help maintain cellular water balance and protect cellular structures from salt stress.

- Antioxidant Defense: High salt levels can generate reactive oxygen species (ROS), which damage cellular components. Medicinal plants have evolved robust antioxidant systems to neutralize ROS and mitigate oxidative stress.

Salinity-Induced Secondary Metabolite Production

Salinity stress often triggers changes in the production of secondary metabolites, which are compounds with diverse medicinal properties. These changes may be adaptive responses to enhance stress tolerance or may represent a reallocation of resources towards defense mechanisms.

- Increased Production: Some medicinal plants increase the production of specific secondary metabolites, such as alkaloids, flavonoids, and terpenoids, under saline conditions. These compounds may possess antioxidant, anti-inflammatory, or antimicrobial properties that contribute to the plant's survival.

- Altered Composition: Salinity may also alter the composition of secondary metabolites, leading to the production of novel or modified compounds with unique medicinal properties.

Applications in Medicinal Plant Cultivation

The understanding of the biology of medicinal plants in saline lands has important implications for their cultivation and use:

- Site Selection: Selecting suitable saline lands for medicinal plant cultivation requires careful assessment of soil salinity levels and the presence of appropriate plant species with known salt tolerance mechanisms.

- Soil Amendments: Amending saline soils with organic matter or gypsum can improve soil structure, reduce salt stress, and enhance plant growth.

- Irrigation Management: Controlled irrigation practices, such as drip irrigation or subsurface irrigation, can minimize salt accumulation in the root zone and reduce plant water stress.

- Harvesting and Processing: Harvesting techniques and post-harvest processing methods should be optimized to preserve the medicinal properties of plants grown in saline lands.

arid and semi-arid regions worldwide.

Conclusion

In conclusion, the biology of medicinal plants being introduced into saline lands is a complex and multifaceted field of study that holds great promise for the future of natural healthcare and environmental sustainability. By understanding the physiological adaptations of these plants, exploring the genetic and biochemical basis of their salt tolerance, and developing sustainable cultivation practices, the scientific community can unlock the vast potential of medicinal plants as a renewable and eco-friendly source of therapeutic agents. As the global demand for natural remedies continues to grow, the successful integration of medicinal plants into saline lands can contribute to the diversification of agricultural systems, the conservation of biodiversity, and the improvement of human health and well-being.

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