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Girdhar K. Pandey
Department of Plant Molecular Biology
University of Delhi South Campus
New Delhi, Delhi, India

Swati Mahiwal
Department of Plant Molecular Biology
University of Delhi, South Campus
New Delhi, Delhi, India

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Preface

Rapid changes in the environment at the global level affect crop productivity. A plant must contain an appropriate amount of nutrients in order to sustain under extreme environmental conditions. The famous trio of nitrogen, phosphorus, and potassium (shortened as NPK) act as a safety gear for plants to withstand harsh environmental conditions. Due to their utmost importance in the growth and development of plants, it is imperative to understand the functions mediated by these nutrients at the cellular level. In this book, role of potassium (K^+) has been briefly discussed, from its importance in agriculture to plant development and stress tolerance.

K^+ plays a key role in all forms of life, starting from a single-cell bacterium to highly complex organisms such as plants and animals. However, the K^+ content in each organism is quite variable, probably due to the unique cellular requirements and diversity in function. It is most abundantly present in plants among all the life forms on Earth. Talking about its importance, one can say that some of the roles played by K^+ are basic in origin as they are required in the basic functioning of a cell.

Universal roles of K^+ have been described briefly in Chap. 1. Apart from its role as a nutrient, it is a major intracellular ion required for osmotic balance in a cell. Since it is important for osmotic balance in a cell, cells must maintain K^+ homeostasis in order to maintain cell structure and turgidity throughout their life. In Chap. 2, a brief glance of homeostasis mechanism in bacteria, yeast, animals, and plants have been discussed. K^+ homeostasis in a cell is maintained by well-defined transporters and channels. Chap. 3 places a spotlight on K^+ transport systems in plants and discusses briefly the K^+ channels and transporter families in plants along with their regulation. K^+ transport system shows a high level of conservation among all kingdoms, which have been briefly discussed in Chap. 4. They are known to have common characteristic features and similarity in structure, especially in the pore region. Evolutionary conservation among plant channels and transporters has been determined, showing their overall conservation in the plant kingdom as well as how they have diverged so far from their last common ancestors.

For plants, the extreme importance of K^+ can be understood by its crucial role in plant development. Though well-known for its role in opening and closing of stomata, it is required at almost every stage of development as well as growth. Chap. 5 provides a broader view of the role played by K^+ in plant growth and development. In their entire life cycle, plants often encounter precipitous abiotic stresses such as drought, waterlogging, low temperature, and high salinity. Chap. 6 reflects on all these types of abiotic stresses providing a clear picture of interplay of K^+ in these stresses. Another challenge faced by plants is the constant change in nutrient availability that depends on the availability of nutrients in the soil. As K^+ is very limited in the soil, there are likely chances of plants facing K^+ deficiency. Chap. 7 provides brief insight into K^+ deficiency, explaining common symptoms of K^+ deficiency that are quite visible in plants. K^+ deficiency acts as stress signal in plants to switch on various mechanisms, enabling cellular machinery to replenish overall K^+ availability in plants. The overall mechanism revealing how K^+ deficiency is actually being sensed in the plants is yet to be deciphered. Speculations have been made that the response to K^+ deficiency is initiated at the roots. Chap. 8 highlights the various possible mechanisms that have been suggested to sense K^+ deficiency in plants.

Besides all the aforementioned functions of K^+ in cells, several other roles of K^+ in plant such as biotic stress responses have now come into the limelight. These newly emerged roles have been described in Chap. 9. But it needs to be emphasized that these roles need to be established well with strong evidence. Nevertheless, more experimental proofs might soon connect plant K^+ homeostasis with biotic stress resistance. Also, the concept of of K^+ as a second messenger is a challenging issue because of its limited properties that do not go well with the characteristic features required for a second messenger. This needs to be further investigated by experiments with solid proof. Chap. 10 deals with several key questions and future perspectives in this area. In summary, it can be concluded that K^+ is a versatile and indispensable nutrient required by plants for their proper growth and development.

New Delhi, India

Girdhar K. Pandey
Swati Mahiwal

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