Role of potassium in plants

Mukesh Kumar Khokhar

Department of Plant Pathology, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, UDAIPUR (RAJASTHAN) INDIA (E-mail: khokharmk3@gmail.com)

Potassium (K) is one of sixteen essential nutrients required for plant growth and reproduction. It is classified as a macronutrient, as are nitrogen (N) and phosphorus (P). The chemical symbol for potassium is "K." It is taken up by plants in its ionic form (K+). The word potassium translates from the Latin or German word, Kalium. The term "potash" comes from the colonial practice of burning wood in large pots and using the ashes as fertilizer and making soap, gunpowder and glass. "Potash" is defined as K_2O and is used to express the content of various fertilizer materials containing potassium, such as Murate of potash (KCl), sulfate of potash (K_2SO_4), double sulfate of potash and magnesium ($K_2SO_4 \cdot 2MgSO_4$), and nitrate of potash (KNO_3).

Role of potassium in plants: While potassium is not a constituent of any plant structures or compounds, it plays a part in many important regulatory roles in the plant. It is essential in nearly all processes needed to sustain plant growth and reproduction. Potassium plays a vital role in:

Enzyme activation: Potassium "activates" at least 60 different enzymes involved in plant growth. The K changes the physical shape of the enzyme molecule, exposing the appropriate chemically active sites for reaction. Potassium also neutralizes various organic anions and other compounds within the plant, helping to stabilize pH between 7 and 8...optimum for most enzyme reactions.

Stomatal activity (Water use): Plants depend upon K to regulate the opening and closing of stomata's...the pores through which leaves exchange carbon dioxide (CO_2), water vapor, and oxygen (O_2) with the atmosphere. Proper functioning of stomata's is essential for photosynthesis, water and nutrient transport, and plant cooling. When K moves into the guard cells around the stomata's, the cells accumulate water and swell, causing the pores to open and allowing gases to move freely in and out.

Photosynthesis: The role of K in photosynthesis is complex. The activation of enzymes by K and its involvement in adenosine triphosphate (ATP) production is probably more important in regulating the rate of photosynthesis than is the role of K in stomatal activity.

Transport of sugars: Sugars produced in photosynthesis must be transported through the phloem to other parts of the plant for utilization and storage. The plant's transport system uses energy in the form of ATP. If K is inadequate, less ATP is available, and the transport system breaks down. This causes photosynthates to build up in the leaves, and the rate of photosynthesis is reduced. Normal development of energy storage organs, such as grain, is retarded as a result. An adequate supply of K helps to keep all of these processes and transportation systems functioning normally.

Water and nutrient transport: Potassium also plays a major role in the transport of water and nutrients throughout the Plant in the xylem.

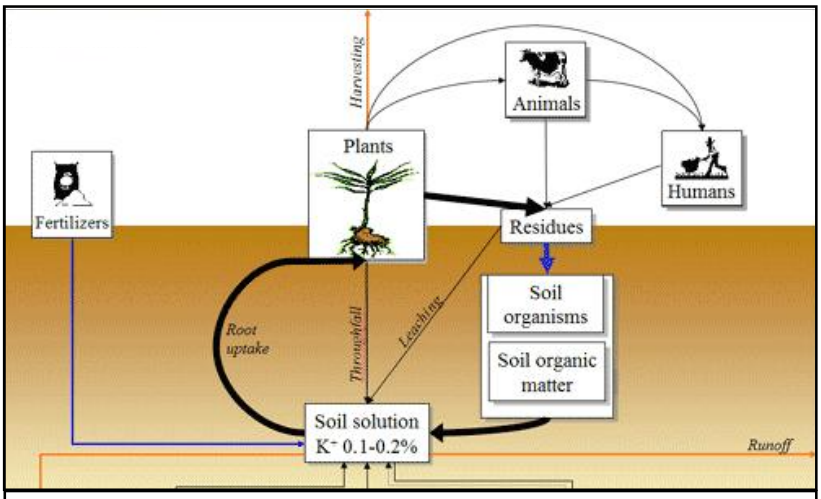

Fig. : Potassium cycle

Protein synthesis: Potassium is required for every major step of protein synthesis.

Starch synthesis : The enzyme responsible for synthesis of starch (starch synthetase) is activated by K.

Crop quality : Potassium plays significant roles in enhancing crop quality. High levels of available K improve the physical quality, disease resistance, and shelf life of fruits and vegetables used for human consumption and the feeding value of grain and forage crops. Fiber quality of cotton is improved. Quality can also be affected in the field before harvesting such as when K reduces lodging of grains or enhances winter hardiness of many crops.

Potassium increases crop yields because it:

– Increases root growth and improves drought tolerance
– Builds cellulose and reduces lodging
– Enhances many enzyme actions

- Aids in photosynthesis and food formation
- Helps translocate sugars and starches
- Produces grains rich in starch
- Increases protein content of plants
- Maintains turgor, reduces water loss and wilting
- Helps retard crop diseases and nematodes

Deficiency symptoms: Potassium is very mobile in plants. As it is readily transferred from older leaf and root tissue to growing points, deficiency symptoms first appear in recently matured and older leaves. Deficiency symptoms are best described as leaf scorch. This develops from an initial yellowing of interveinal areas near the leaf margins. This is followed by tanning and browning, and finally drying of the tissue to appear as scorching. This scorching is at first confined to the leaf margins and tips but progresses inwards as the deficiency becomes more severe, until the whole leaf may be affected. Rarely does the growing point show deficiency symptoms. Leaves from potassium deficient plants have a flaccid (wilted) appearance and the tips and margins are often frayed. Plant growth is retarded and root systems are poorly developed. Potassium balance with other nutrients, particularly the other cations (positively charged ions) such as calcium and magnesium is of importance. Too much potassium can induce deficiencies of other nutrients, while potassium deficiency

Potassium fertilizers : Murate of Potash - is potassium chloride (KCl). It is the most economical of the potassium fertilizers and therefore the most widely used. Other potassium fertilizers are used where the chloride in Murate of Potash may be detrimental, eg. In saline soils, where poor quality irrigation water is used, in crops such as tobacco which are sensitive to chloride, and where potassium is foliar-applied (where the chloride will burn the foliage).

Sulfate of Potash or potassium sulfate has a lower salt index than Murate of Potash, and is often preferred to the latter in crops sensitive to chloride or susceptible to fertilizer burn, eg. To the crop roots. It is often used in planting mixtures for French bean, and in shallow-rooted tree crops.

Potassium nitrate is also known as Nitrate of Potash and Saltpeter. It is not widely used on account of its cost, but finds use in crops sensitive to chloride, eg. Tobacco, and in solution (through irrigation systems and as a foliar spray). It is more soluble than potassium sulfate.

Received : *15.09.2012* ***Revised :*** *15.04.2013* ***Accepted :*** *16.05.2013*