

POTASIUM: Deficiency symptoms, source, functions in plant biology

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Abstract

Potassium is one of the major nutrients, essential for plant growth and development. With the intensification of Indian agriculture importance of potassium (K) has increased because potassium is widely regarded as the “quality element” for crop production. It is found in large concentrations (100-200 mM) in the plant cell sap. Potassium is not incorporated into the structure of organic compounds but remains in ionic (K⁺) form in the cell and is mobile in plants. Potassium is required for the activation of over 80 enzymes.

It plays vital roles in:

- (i) Water relations (osmotic regulation, control of ionic balance etc.).
- (ii) Energy relations and translocation of assimilates.
- (iii) Photosynthesis, protein and starch synthesis.
- (iv) Metabolic processes and grain/seed formation.
- (v) Improving quality of flowers, fruits, vegetables and other field crops in terms of size, shape, color, taste, shelf-life and fiber quality etc. Providing resistance against pests and diseases.
- (vi) Preventing lodging in crops. Imparting resistance against environmental stresses such as drought, cold and frost.

Deficiency Symptoms:

Potassium deficiency does not manifest immediately in the form of visible symptoms. At first the growth rate decreases and deficiency symptoms appear at later stages. Under restricted K supply potassium deficiency symptoms generally appear on older leaves. In most plant species, tips and margins of older leaves turn yellow (chlorosis) and then die (necrosis) giving a burning look on edges. In several important forage and cover crop legume species potassium deficiency produces small white necrotic spots that form a unique pattern along the leaflet margins this easily recognized symptom is often mistaken for insect

damaged disease infection. Potassium deficiency leads to (i) slow and stunted growth (ii) weak stalks and susceptibility to lodging, pests, diseases, frost etc. (iii) low yield and (iv) poor quality of produce.



Potassium deficiency in Mustard



Potassium deficiency in Soyabean



Potassium deficiency in Tomato



Potassium deficiency in Cotton



Potassium deficiency in Maize

Seeds from potassium-deficient plants are small, shrivelled and are more susceptible to diseases. Fruit is lacking in normal coloration and is low in sugar content. Vegetables and fruits have a short shelf-life and deteriorate rapidly when shipped.

Management of Potassium:

Sources of Potassium and their Suitability:

Potassium content of fertilizers is expressed as K_2O although there is no such compound in fertilizers nor it is absorbed by or found in the plant in that form. Soil and plant tissue analyses values are usually expressed in terms of percent potassium (K) and fertilizer recommendations are expressed as K_2O .



India has no potash-rich soluble minerals incrustation. Hence all the fertilizer K used in Indian agriculture is imported. Potassium chloride or muriate of potash (MOP) constitutes 99% and sulphate of potash (SOP) one percent of the total K fertilizer use. Muriate of potash (MOP) contains 60% K_2O (50% K) and SOP contains 50% K_2O (41.5% K). MOP is cheaper than SOP, since it is the raw material for the manufacturing of SOP. Some crops are sensitive to high amount of potassium chloride. These include tobacco, grapes, fruit trees, cotton, sugarcane, potatoes, tomatoes, straw berries, cucumber and onions. It is preferable to apply SOP to these crops. Oil palm and coconut on the contrary appear to be chloride loving crops and perform well with the application of MOP. Potassium nitrate containing 44% K_2O (37% K) and 13% N is preferred fertilizer for spraying on fruit trees and horticultural crops. Recent studies in India have shown that schoenite (a double salt of potassium and magnesium) is as good a source of potassium as MOP for groundnut, banana, rice, wheat and maize.

Indigenous sources of potassium like wood ash, manure, crop residues, distillery and coir wastes, cement kiln dust etc. Can also be used wherever they are available to minimize the use of costly fertilizers.

Methods of Potassium Application:

Potassium fertilizers are generally broadcasted or spread on the surface and mixed with surface soil. Only in the soils with a low level of available K or with a high K-fixing capacity band placement is recommended. In some soil crop situations split application is emerging as an alternative to basal application. These situations are: (i) rice grown in light-textured soils and acid soils in high rainfall are as in order to reduce leaching losses, (ii) low tillering and late maturing varieties, where the natural supply of K from soil plus irrigation water decreases in the later stages of crop growth, (iii) in highly reduced soils where conditions may hinder K uptake and (iv) during the monsoon season. Split application of both N and K in rice is recommended in Andhra Pradesh, Kerala, Orissa and Uttar Pradesh. Split application of K is also recommended in crops like sugarcane, banana, grape vines, papaya, pineapple and tea indifferent states. Potassic fertilizers and K-rich organic (poultry manure, biogas slurry, pulse residues, rice straw, vermicompost etc.) and inorganic sources are being used in crops which remove large amount of K or in commercial crops for quality consideration.