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Response of Plant through Application of Potassium

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Abstract

Crops need potassium (K) in approximately equal amounts as nitrogen (N), and it is essential for numerous metabolic processes in plants. Inadequate K application causes soil K mining, signs of a K deficit in plants, and lower agricultural yields and quality. Crop K requirements varies depending on crop varieties, growth habits, nutritional requirements at various physiological stages, and yield. In addition to being a structural component of plants, potassium also plays a regulatory role in a number of metabolic activities such as protein synthesis, glucose metabolism, and enzyme activation. K has just been discovered to provide resistance to abiotic stress.

Keyword: Potassium, metabolic Process, Quality, Yield and Abiotic Stress

Introduction: Potassium is a crucial plant nutrient that is needed in high quantities for healthy plant growth and reproduction. Potassium (K^+), which may make up to 10% of the dry mass in plant cells, is the main inorganic ion. The rate-limiting factor for crop production and quality is known to be K^+. It significantly contributes to cellular hydrostatic (turgor) pressure, growth, and reactions to environmental changes as a stabiliser in metabolism and as an osmotic contributor. The activation of enzymes, stabilisation of protein synthesis, neutralization of protein negative charges, formation of membrane potential in conjunction with the proton motive force, and maintenance of cytosolic pH homeostasis all depend on high and relatively stable potassium concentrations in specific cell compartments. When it comes to nutrients required by plants, potassium is second only to nitrogen and is sometimes referred to as the "quality nutrient." To achieve excellent yield, increased farm revenue, and maximum nutrient usage efficiency, science-based K application in crops must adhere to 4R Nutrient Stewardship. Studies from all around the globe, from tropical to temperate regions, reveal widespread K insufficiency.

Functions of potassium:

1. Required for the formation of chlorophyll and photosynthesis.
2. It controls ion transport throughout the plants, earning it the nickname "traffic policeman of the plant."
3. 2. It increases plant vigour so that they can withstand harsh weather conditions.
4. Reduces lodging in cereal crops.
5. It controls the opening and closure of stomata.
6. Enzyme activation, enzyme synthesis, and peptide bond synthesis.
7. Controls the plant's H_2O imbalance.

Table 1 K-status in India

Year	K		
	Consumption	Production	Imports
2011-12	25.75	0.00	33.35
2012-13	20.62	0.00	12.30
2013-14	20.99	0.00	13.33
2014-15	25.32	0.00	25.37
2015-16	24.02	0.00	20.53
2016-17	25.08	0.00	23.25
2017-18	27.79	0.00	28.95
2018-19	25.29	0.00	26.29
2019-20	26.07	0.00	22.8
2020-21	31.54	0.00	26.7

*Source:*DepartmentofFertilizersandDepartmentofAgriculture&FarmersWelfare

Crop Quality and potassium: Significant contributions from potassium improve crop quality. The physical quality, disease resistance, and shelf life of fruits and vegetables used for human consumption as well as the feeding value of grain and forage crops are all enhanced by high levels of readily accessible K. Prior to harvest, quality may also be impacted by factors including K's ability to improve many crops' winter hardiness or prevent grain lodging. The farmer who neglects to maintain soil K levels in the range high enough to deliver enough K at all times throughout the growing season loses money due to this "hidden hunger."

Uptake of Potassium: Different variables affect the bioavailability and absorption of K by plants from the soil. The correct absorption and transport of potassium by plants are substantially determined by the rate of respiration by plants. Its absorption is reliant on enough energy (ATP). The movement of critical nutrients, water, and other things from the roots through the stem to the leaves depends on potassium.

Numerous factors influence the uptake of potassium by plants.

- **Soil texture:** As the texture increases, fixation will follow, and vice versa.
- **Wetting and drying:** Fixation is more prevalent in a dry state than a wet one.

- **The fixation** rate is higher in the 2:1 kind of day than the 1: 1 type.
- **Freezing and thawing:** Depending on the clay mineralogy and degree of weathering, this process improves the fixation of K.
- **Soil pH:** A drop in pH inhibits K fixation either as a consequence of H3O+ competing for the interlayer exchange position or as a result of pH changes.
- **Soil temperature:** The lower temperature inhibits plant development and K absorption, slowing down plant processes.
- **Soil aeration:** Root development is constrained, oxygen supply is decreased, and k absorptions are retarded in soils with high moisture content or compact soils.
- **Ca and Mg:** K uptake would be decreased as Ca^{2+} and Mg^{2+} were raised, or as the supply of K was increased, K uptake would be decreased as these two cations were increased.
- **Tillage System:** Ridge-till and no-till planting methods both diminish the soil K availability. Research findings suggest that the spread of roots in the soil is constrained along with limits on root development.

Lack of potassium in plants

- Potassium shortage may result in anomalies in plants, with symptoms often relating to growth.
- Potassium shortage does not instantly cause symptoms that are noticeable. Early growth rate declines are followed by subsequent deficiency symptoms. The elder leaves are where the first signs of a deficiency appear.
- A chlorosis along the edges, followed by browning and blistering of the tips of older leaves that progressively move inside and give the impression of burning.
- Plant lodging with sluggish development.
- Seeds and fruits that have shrunk.
- Crop yields can be decreased without any overt indications; this condition is referred to as hidden hunger.
- A decrease in the ability to withstand certain plant diseases and quality
- Potassium deficit alters the activities of enzymes like invertase and catalase in crops like sugarcane.

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Injury due to excess K application

- An abundance of this element tends to postpone maturity.
- Causes deficits in calcium, magnesium, and iron.

Correction measures:

High potassium chloride concentrations may harm certain crops. These include onions, cucumbers, potatoes, tomatoes, straw berries, cotton, grapes, cotton, fruit trees, sugarcane, and tobacco. On the other hand, it seems that coconut and oil palm are plants that like chloride.

Potassic fertilizers are often administered as a basal dosage, although split application is advised for light textured soils. For light soils, it is advised to apply N and K in separate applications. Spraying horticulture crops and fruit trees with potassium nitrate is favoured since it contains 44 percent K_2O (37 percent K) and 13 percent N. Farmers also use KNO_3 spraying to increase their crops' cold resilience throughout the winter (rabi season).

Placement of potassium fertilizers:

Placement:

The typical potassium fertilizers have a high salt index in certain circumstances and are entirely water soluble. Consequently, they may reduce seed germination and plant survival when put too near to seeds or transplants. A good way to avoid fertilizer harm is to apply the fertilizer in a band that is 2 inches below the seed and about 3 inches to the side. When potassium levels in the soil are low or the rate of application is low, band placement of potassium fertilizer is often more effective than broadcast application.

Broadcast:

With traditional tillage, potassium is spread throughout the plough layer, but with minimal tillage, the majority of the applied potassium remains in the top 1 to 2 inches of the soil. Due to its large root system in the soil's top layer, corn often absorbs enough potassium when grown without tillage.

Estimating potassium needs:

Both normal soil testing techniques and plant analysis may be used to monitor the K status of soils. Plant analysis may be performed to regularly check the results of a

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specified fertilizer programme or to validate a suspected deficit indicated by visual signs. Table: -3 offers an explanation for K levels in plant tissue.

Table2. Sufficiency levels of potassium for major agronomic crops, vegetables, and fruit

Crop	Plant Part	Time	Sufficiency range(% K)
Alfalfa	Tops (6"newgrowth)	Prior to flowering	2.0-3.5
Apple	Leaf from middle of current terminalshoot	July15- August15	1.2-1.8
Blueberry	Young mature leaf	First week of harvest	0.4-0.7
Broccoli	Young mature leaf	Heading	2.0-4.0
Cabbage	Half –grown young wrapper leaf	Heading	3.0-5.0
Carrot	Young mature leaf	Mid-growth	2.8-4
Cauliflower	Young mature leaf	Buttoning	2.6-4.2
Corn	Whole tops	Lessthan12"tall	2.5-3.5
Edible bean	Most recently matured trifoliate	Bloom stage	1.5-3.3
Grape	Petiole from young mature leaf	Flowering	1.5-2.0
Soybean	Trifoliate leaves	Early flowering	1.7-2.5
Spring wheat	Whole tops	As head emerges from boot	1.5-3.0
Strawberry	Young mature leaf	Mid-August	1.1-2.5
Sweet corn	Ear leaf	Tasseling to silk	1.8-3.0
Sugar beet	Recently matured	50-80 days after	2.0-6.0

	leaves	planting	

Source: Bryson *et al*. (2014)

Table3.Rating chart of soil test values for k for [ammonia acetate method (kg/ha)]

Soil test potassium (kg/ha)	Rating
<108	low
108-280	medium
>280	high

The greatest management tool for estimating the quantity of potash required in a fertilizer programme is the soil K test. By calculating the sum of solution K (water = soluble K) and exchangeable K, one may calculate theK in soils.

Conclusion

Being vital to several plant activities that have an influence on crop output, quality, and plant health, potassium is an essential nutrient for crop development. It is needed in very high amounts, with cereals absorbing a peak of more than 250kg/ha at the end of flowering. Due to potassium's strong interactions with nitrogen during root absorption and plant use, the need of a balanced diet is made abundantly obvious. Lack of potash will not only result in less effective nitrogen usage, but it will also raise the likelihood of drought, increase lodging, reduce photosynthesis, and impede the flow of water, nutrients, and carbohydrates throughout the plant.

References

Brysonetal.(2014),Plant Analysis Handbook III; Rosen and Eliason (2002) , Nutrient Management for Commercial Fruit and Vegetable Cropsin Minnesota.