# *A Review on Potassium in the soils and methods of Detection*

**G. G. Sarate[1, 3], Ravindra Borkar[4], S. V. Mapare[1, 2]**
*Department of Electrical and Electronics*
*Sant Gadge Baba Amravati University, Amravati[1]*
*Vidyalankar Institute of Technology,Wadala, Mumbai[2],*
*Government Polytechnic, Yavatmal[3]*
*Mahatma Gandhi Aantarrashtriya University, Wardha[4]*
***Corresponding Authors' email id:*** *ggsanshu@rediffmail.com[1], smapare@gmail.com[2]*

***Abstract***
*The appearance of potassium existing in soils, potassium release and plant available potassium is discussed. The past development of the methods for detection and analysis of the potassium are discussed. This paper gives review of sensing technology and other portable methods used to determine the soil potassium.*

***Keywords:*** *Potassium, soil, fixation of potassium, potassium availability, prediction, LED, optical detector, near infrared*

## INTRODUCTION

Potassium is an essential plant nutrient and is required in large amounts for proper growth and reproduction of plants. Potassium is one of the quality nutrient required for plants along with nitrogen and phosphorous. The determination of potassium in soil by various methods has been carried over the years. Many researchers tried to invent the method that gives the information regarding the soil potassium contents [1]. There are various methods to determine soil potassium, the flame spectrometry or atomic absorption spectrometry for potassium. The optical methods are reliable, but time-consuming, complex and high cost per test [2]. Optical reflectance method with visible infrared and mid infrared frequencies gives the great result including soil organic matter soil minerals and some soil nutrients. Optical sensor plays important role in determination of soil potassium.

With the help of the sensor we can estimate proper ratio of nutrients in the soil, and then accordingly farmers can use ratio of fertilizers [4]. This resulted in the limitation of the number of soil samples tested for characterizing the spatial variability of soil potassium in a field or fields. Therefore, novel soil potassium detection methods are urgently needed.

## FORMS OF POTASSIUM IN SOIL

Unavailable Potassium: Depending on soil type, approximately 90-98% of total soil potassium is found unavailable. Most of the potassium is found in clays and micas. Plants cannot make use of the potassium in this crystalline-insoluble form. Over years of time, these minerals are go a break down and potassium is released. This process, however, is too slow to fulfil supply of K needs of field crops. As these minerals totally are not available to plants, some K moves towards the slowly available potassium group. Some may move to the readily available group Fig.1.

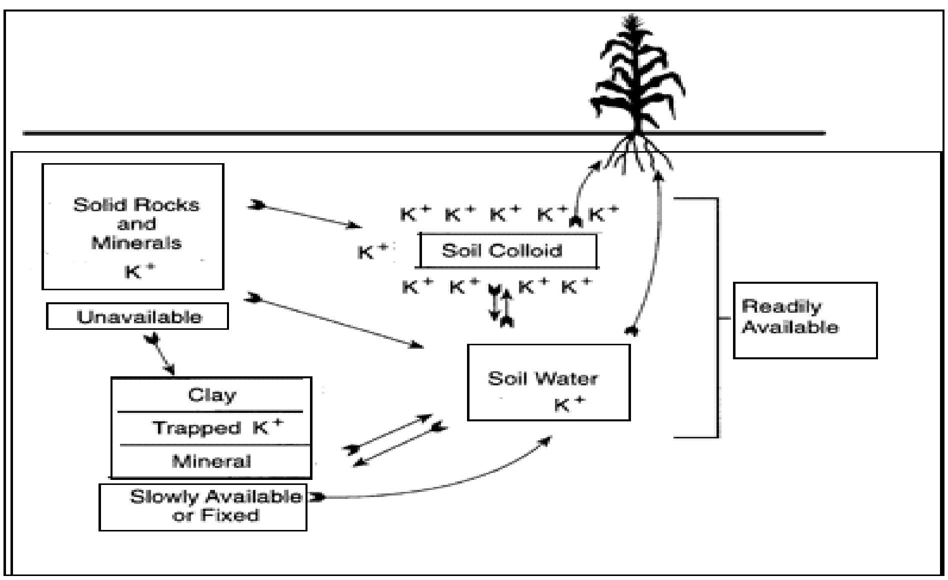


***Figure.1. Potassium flow***

***Potassium Available slowly :*** There is some potassium that is considered to be lock in between layers of clay minerals and is commonly referred to as being fixed and immobile. Growing plants cannot use much of the slowly available K for the period of a sole growing period. This trapped potassium is the available K but not measured by the routine soil testing procedures since it releases the potassium ions slowly. This type of available K may also serve as a basin for readily available K over a period of time. Some slowly available K may get released for plant use during a growing season, some of the readily available K may also get trapped and fixed between clay layers and thus converted into slowly available potassium **Fig.1.**

The amount of potassium fixed in the slowly available form varies with the type of clay that dominates in the soil. Clays are dominant in many of soils. These clays fix K when soils become dry because K is trapped between the layers in the clay mineral. This K, however, is released when the soil becomes wet. Illite clays are dominant in most of the soils. These clays also fix potassium between layers when they become dry, but do not release all of the fixed potassium when water is added. The process of trapped potassium getting fix without being release causes problems for the availability of potash fertilizers for crop production in that region.

***Readily Available Potassium :*** Potassium that is dissolved in soil water (water soluble) plus that is held for the exchange from clay particles (transferable potassium) is considered voluntarily available for plant growth. The exchangeable potassium ions found on the peripheral of clay particles are easily available for being absorbed by plants. This is the form of K measured by the regular soil testing method.

Plants with good grace absorb the K dissolved in the soil water. As soon as the K concentration in soil water drops, more potassium is released into this solution from the K attached to the clay minerals. The K attached to the replacing sites on the clay minerals is more with good grace available for plant growth than the K trapped between the layers of the clay minerals.

## ELECTROCHEMICAL SENSORS FOR SOIL

An electrochemical sensor consists of an ion selective membrane, which selectively responds to a target ion, and a transducer that converts the physical parameter into detectable electrical signals. Ion Selective Electrode (ISE) and Ion Selective Field Effect Transistor (ISFET) are two types of most commonly used potentiometric electrochemical sensors for soil potassium detection [5]. The response mechanism of ISE method can in brief explained by the Nernst equation as a change of an ISE's potential, compared with a reference electrode, is linear to the change of the target ion activity (measured in logarithmic units). ISEs were reported to detect soil nitrate [7,9],ammonium [8] and potassium [10]. ISEs have not been ready used for real-time sensing applications because of their slow response (several minutes).

Ion Selective Field Effect Transistor-ISFET is the integration of an ISE and a field effect transistor (FET). The ion selective membrane is placed on the top of the insulator layer of the FET structure, so the threshold voltage of the ISFET may be chemically modified and the measured voltage is interrelated with the target ion concentrations. ISFETs have several advantages over ISEs, such as miniature dimensions, lower output impedance, high signal-to-noise ratio, fast response and the capacity to incorporate multi-ISFETs on single chip.

The three methods explicitly are Visible-Near infrared [Vis-NIR], Near infrared [NIR] and Mid infrared [MIR] spectroscopy methods are used for performance measurement of soil potassium. Reflectance spectroscopy is chemical analysis that requires complex laboratory testing. Optical method includes LED's and colour developing reagents are efficient and low power consumption methods for potassium detection.

## CONCLUSION

In the future it is required to develop a hand electronic sensor for determination of micronutrients in the soil as the Electrochemical and optical method are chemical based method that are time consuming. Various sensing technologies that include optical and mechanical methods have potential to estimate soil potassium. Ion selective electrode and reflectance spectroscopy are chemical analysis methods that require complex laboratory testing. Optical methods are efficient and low power consumption.

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