Experiment – 05

Estimation of exchangeable potassium in soils (Hanway and Heidel, 1952)

The availability of potassium in soil mainly depends on mineralogy, weathering, crop and its growth period. Availability of potassium is dependent on (i) the amount of K^+ in the chemical pools from which plant uptake occur, i.e. solution (water soluble), exchangeable and some slowly exchangeable K^+, and (ii) its accessibility to roots. The available potassium i.e. exchangeable and water soluble potassium is determined by extracting soil with neutral normal ammonium acetate solution are most commonly used. The estimation of potassium is carried out by flame photometer.

Principle :

Potassium present in soil on the exchange sites of soil colloids can be replaced by suitable cations and thus can be brought into solution for subsequent determination The most commonly used extractant for extracting the exchangeable K is neutral normal ammonium acetate solution. The NH_4^+ ions provided by the extractant very effectively replaces the K^+ ions present on the exchange site, which then associate with the acetate ions and remains in the solution. Along with the exchangeable K, the neutral normal ammonium acetate solution also extracts the water soluble K from the soil. Hence, the amount of exchangeable K in soil can be obtained by subtracting the amount water soluble K from the amount of ammonium acetate extractable K.

Apparatus and reagents :

a) Flame photometer with red filter

b) Mechanical shaker

c) Pipette, volumetric flasks and conical flask (100 ml).

Reagents :

(b) Neutral Normal Ammonium Acetate : Dissolve 77.08 g of AR gradeAmmonium acetate (CH_3COONH_4) in about 700 ml distilled water in a 1000 ml volumetric flask.Adjust the pH to 7.0 with ammonia solution or glacial acetic acid and make the volume with distilled water.

(c) Standard Potassium Solution : Dissolve 1.9066 g of dried KCl (AR) in distilled water and dilute to one litre. This is 1000 mg kg^{-1} K solution. 100 ml of this solution diluted to 1 lit. to make 100 ppm K solution.

Preparation of the standard curve :

Recently available models of flame photometer directly give the readings in the same unit as of the working standard solutions, hence does not require any standard curve to be prepared. For older versions of flame photometer, take 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 ml of 100 mg kg^{-1} K solution in different 25 ml volumetric flasks. Make up the volume with 1N NH_4OAc solution. Adjust the flame photometer reading at zero with blank (zero K) solution and at 100 for 40 mg kg^{-1} K solution. Take the flame photometer readings for every dilution. Plot the standard curve on graph paper by taking K concentration on X axis and flame photometer reading an y axis. This will give a factor (F) of 1 flame photometer reading = 0.4 mg kg^{-1} K.

Procedure :

- Take 5g soil in 100 ml conical flask.
- Add 25 ml of 1N ammonium acetate (NH_4OAc) solution.
- Shake the content for 5 minutes and then filter through Whatman No.1 filter paper.
- Measure the K concentration in the filtrate using flame photometer after calibration.

Calculation :

Available K (mg kg^{-1})	=	C x 25/5	=	C x 5
Available K (kg ha^{-1})	=	C x 5 x 2.24		
Available K (cmol [+] kg^{-1})	=	C x 5 x (1/ 390)	=	C x (1/78)

Where :

- C denotes the 'K concentration (mg L^{-1})' in the sample.
- In above calculation 390 data is used for available K (cmol[+] kg^{-1}) is coming from the equivalent of K i.e. 39, hence, 39 K is available in 100 g soil so 390 K is available in 1000 g or one kg soil.

Limits of available K in soil :

Very low	:	Less than 200 K kg ha^{-1}
Low	:	200 – 250 K kg ha^{-1}
Medium	:	250 – 400 K kg ha^{-1}
High	:	400 – 600 K kg ha^{-1}
Very high	:	More than 600 k kg ha^{-1}

Precaution :

a) These should not be any turbidity or suspended particles in extract, it will chock the capillary feeding tube .
b) The gas and air pressure should be constant.
c) If sample reading goes beyond 100 then dilute the extract.