Determination of potassium supply power of some different soils

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Abstract
Neubauer seedling experiment was carried out for determining the K supplying power of different soils, in which seven soils from Iran, besides the three Indian soils were used. In this experiment, 100 seedlings of wheat were made to feed exhaustively on 100 grams of soil mixed with 100 grams of quartz sand for 20 days in plastic dishes. The total K uptake by wheat seedlings from soil was calculated from which the blank value was deducted to obtain the "root-soluble" K in soil. These values are designated as the Neubauer numbers, expressed as mg per 100 g of air-dry soil. The Neubauer limit value for wheat is 20 mg K per 100 g of dry soil and the soils which are having less value than the above is being considered to have poor K supplying capacity. It was observed that the Iranian soils are having more capacity to supply K than the Indian soils. Among the Indian soils, Alfisol, Vertisol, and Inceptisol with Neubauer numbers of 10.4, 8.6, and 2.8 are having highest, medium, and lowest potassium supply power, respectively.

Key Words
Potassium, suply power, Neubauer number and wheat.

Introduction
The potassium supplying power of eleven Ustochrepts of Delhi territory was determined by exhaustive cropping with Sudan grass (*Sorghum vulgare* var. sudanensis) in pots treated with 3 levels of potassium (0, 100, and 300 ppm). The exchangeable K content in the soil and the total potassium content in the plants after each crop were calculated. The residual exchangeable potassium showed a close correlation with the potassium supplying power of the soil (Deshmukh and Khera 1990).

The potassium supplying capacity of soils formed on three geological deposits of Nigeria was investigated by Loganathan *et al.* (1995). Soils formed on recent alluvial materials of the Meander Belt deposits (MBD) had mica and feldspars resulting in very high levels of total K and soils formed on the other two geological deposits (Sombreiro Warri deposits, SWD, and Coastal Plain Sands, CPS) had low levels of total K. Potassium uptake by maize induced a release of NE-K to the plant-available K pool. Potassium supply to plants from the NE-K pool for 3 successive maize crops in MBD, SWD and CPS soils were 303-435, 32-57 and 21-38 µg K /g soil, respectively. NE-K uptake, as a percentage of total K uptake, decreased with successive cropping in CPS soils and reached zero at the third cropping, while in MBD soils the percentage remained constant upto the third and last crop. In this respect, some SWD soils behaved similarly to MBD soils and others to CPS soils.

Surapaneni *et al.* (2002) evaluated a range of soil testing procedures for K for their ability to explain the variability between the 19 soils in both the uptake of total K from the soil and also the apparent uptake of K_{nex}. A new, simple soil testing procedure, involving extraction of soil K with dilute nitric acid (HNO_3- K), was found to be superior to a number of other published procedures, including estimates of exchangeable K (such as Quick Test K) and reserve K (involving multiple extractions with nitric acid), when correlated with dry matter yield and K uptake. An estimate of step K, calculated as the difference between HNO_3-K and Quick Test K, proved to be better than reserve K in explaining variations in K_{nex} uptake. The proposed HNO_3 extraction procedure is simple, cheap, and effective.

A model has been developed by Datta (2001) to simulate maximum K supplying capacity of a soil to a crop from different depths and the amounts of K released or fixed during cropping. The model is based on the equation of continuity with the assumption that nutrient flux from soil to root proceeds by mass flow and diffusion and influx into root follows Michaelis-Menten kinetics. Potassium fixation or release in soil has been simulated by incorporating a sink and source function, respectively, to the equation of continuity with the hypothesis that K release takes place in soil when K concentration goes below Release Threshold Level (*RTL*) and fixation takes place when K concentration goes above Fixation Threshold Level (*FTL*). This model has been validated and has been applied to simulate response towards fertilizer application at different available K. It has been shown that maximum response occurs at a particular value of available K which shifts towards higher value as *RTL* increases.

Methods

This experiment was done for determining the K supplying power of different soils, in which 12 soils from Iran, besides the 3 major Indian soils were used. In this technique, 100 seedlings of wheat were made to feed exhaustively on a limited quantity of soil (100 g) mixed with 100 g of quartz sand for 20 days in dishes of 11 cm diameter and 7 cm depth. A blank without any soil was also run. The total K uptake by seedlings from soil was calculated from which the blank value was deducted to obtain the "root-soluble" K in soil. These values are designated as the Neubauer numbers, expressed as mg per 100 g of air-dry soil.

Results

In this experiment, 100 seedlings of wheat were made to feed exhaustively on 100 grams of soil mixed with 100 grams of quartz sand for 20 days in plastic dishes. From the results of the Neubauer seedling experiment the Neubauer number (total potassium uptake by crop from 100g of a particular soil–total K uptake from control, that is, without soil) was calculated and is presented in Table 1. The Neubauer limit value for wheat is 20 mg K per 100 g of dry soil (Singh *et al.* 1999) and the soils which are having less value than the above is being considered to have poor K supplying capacity.

Table 1. The Neubauer number (mg K per 100 g soil) for different soils under study.

Soil order/ Location	Available K (mg/kg)	Dry matter yield (g) Shoot	Root	Total	K Uptake (mg./pot) Root	Shoot	Total	Neubauer Number
Inceptisol	60.8	1.39	1.42	2.81	3.70	6.03	9.73	**2.8**
Vertisol	158.0	1.47	1.37	2.84	5.00	10.5	15.5	**8.6**
Alfisol	50.3	1.64	1.62	3.26	6.85	10.5	17.4	**10.4**
Karkandeh	176.0	1.28	1.38	2.66	7.13	25.8	32.9	**26.0**
Golafra	52.9	1.59	1.59	3.18	5.10	23.9	29.0	**22.1**
Ilvar	76.6	1.68	1.70	3.38	6.63	27.6	34.3	**27.3**
Shamoshak	83.5	1.84	1.60	3.44	9.53	38.9	48.5	**41.5**
Kordkoy	98.1	1.79	1.55	3.34	8.70	41.5	50.2	**43.3**
Seejwal	255.0	1.68	1.61	3.29	11.2	38.5	49.8	**42.8**
Qara-ghashli	190.0	1.56	1.52	3.08	9.83	35.1	44.9	**38.0**
Blank	-	1.01	1.23	2.24	2.90	4.05	6.95	**-**

Conclusion

As evident from the data presented in Table 1, the capacity of Iranian soils to supply potassium is much more than Indian soils (at least double) and this is because of higher amount of solution K in Iranian soils as compared with Indian soils. Among the Indian soils, Alfisol, Vertisol, and Inceptisols with Neubauer numbers of 10.4, 8.6, and 2.8 are having highest, medium, and lowest potassium supply power, respectively.

References

Datta SC (2001) 'Annual reports of division of Soil Science and Agricultural Chemistry'. (Indian Agricultural Research Institute: New Delhi).

Deshmukh VN, Khera MS (1990) Potassium supplying power of some Ustochrepts under exhaustive cropping and varying external supply. *PKV Research Journal* **14,** 107-111.

Loganathan P, Dickson AA, Isirimah NO (1995) Potassium supplying capacity of soils formed on different geological deposits in the Niger Delta region of Nigeria. *Geoderma* **65,** 109-120.

Singh D, Chhonkar PK, Pandey RN (1999) 'Soil Plant Water Analysis: A Methods Manual'. (Indian Agricultural Research Institute: New Delhi, India).

Surapaneni A, Tillman RT, Kirkman JH, Gregg PEH, Roberts AHC (2002) Potassium-supplying power of selected Pallic soils of New Zealand 2. Soil testing procedures. *New Zealand Journal of Agricultural Research* **45,** 123–128.