Potassium availability releasing power and Uptake of K by chickpea and rajmash in different pulse growing regions of India

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Potassium availability, releasing power and uptake by chickpea and rajmash in different soil types of pulse growing regions of India

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ABSTRACT

Potassium, releasing capacity and uptake by chickpea and rajmash in different soil types of pulse growing regions were studied. Readily available forms of K *viz.*, water soluble K, 0.01 M $CaCl_2$ K and 1N NH_4OAc K were higher in Vertisols compared to Alfisols and Inceptisols. However, strongly held non-exchangeable K (boiling 1N HNO3 extractable) was much high in Inceptisols than other soils types. Potassium releasing power studied in terms of step K and constant K rate indicated that mean step K was maximum in Inceptisols (2742 mg/ka), followed by Vertisols (2209 mg/kg) and minimum was in Alfisols (514 mg/kg). Wide variations were observed in K uptake by chickpea and rajmash amng soil types as well as within each soil type. In both the crop plants, shoot maintained higher K content and uptake. Rajmash removed greater amounts of K than chickpea. Available K extracted in NH_4OAc showed better index for plant K availability in Inceptisols and Vertisols than Alfisols.

Key words : Potassium availability, Release, K uptake, Soil types, Pulse growing regions

INTRODUCTION

In India, the major pulse growing states are Madhya Pradesh, Uttar Pradesh, Maharashtra, Rajasthan, Karnataka, Andhra Pradesh, Gujarat, Bihar, Tamil Nadu and Jharkhand. Different soils representing alluvial, medium and deep black and red and laterites are found in these states (15). Potassium status of these soils varies considerably from low to high according to soil type, parent material, texture and management practices. Potassium requirements of pulse crops are as high as 50 kg per tonne of grain yield, whereas K application to these crops is almost missing and therefore, major part of plant K demand is met from non-exchangeable/reserve K fraction in soil under intensive cropping (11). Intensive cropping system with huge removal of K by different crops wthout K addition has led to progressive depletion of soils reserve K. Therefore it was suggested that non-exchangeable K should be included as a measure in soil test calibration and K recommendations (13). Soil reserve K varies widely among soils depending upon texture, parent material, mineraology of soils, therefore, the rate at which K is released from this fraction is important. Release of interlayer K is very slow to meet the K uptake rates particularly during sensitive stages. To simulate the release of soil reserve K over a period of time, Haylock (5) proposed repeated extraction of soil with boiling 1N HNO_3, which gives pattern of K release as a measure of plant utilizable reserve K. Present study examines available forms of K, release characteristics and K uptake by two important *rabi* pulses, chickpea and rajmash, in predominant soil types of pulses growing regions.

MATERIALS AND METHODS

Bulk surface soil samples (0-15 cm) from 10 locations representing 4 alluvial soils belonging to Inceptisols (Kanpur, Faizabad, Delhi and Varanasi), 3 black soils under Vertisols (Sehore, Raipur and Gulbarga) and 3 red soils under Alfisols (Hyderabad, Ranchi and Bangalore) representing regions of intensive pulses based cropping systems were used in the present study. The soil samples were processed and analyzed for particle size, organic carbon, pH and EC (6). Details of soil properties and taxonomy are presented in Table 1. Different forms of K *viz.*, water-soluble, 0.01 M $CaCl_2$ (18) and 1N NH_4OAc (4) extractactable K and 1N boiling HNO_3 K (17) were determined in soil samples. In all the extractions, K was determined by flame photometer. Exchangeable and non-exchangeable K contents in soils

Table 1. Important properties of surface soil

Soil	pH (1:2.5)	EC (d S m^{-1})	Org. C (%)	Clay (%)	Texture
Inceptisols					
Kanpur	7.60	0.38	0.30	20.6	Silty loam
Faizabad	9.28	0.43	0.35	24.6	Silty loam
Delhi	7.58	0.22	0.42	18.0	Loam
Varanasi	7.56	0.25	0.31	23.5	Loam
Vertisols					
Sehore	7.85	0.23	0.46	61.5	Clay
Raipur	7.30	0.12	0.41	65.5	Clay
Gulburga	7.77	0.25	0.38	70.6	Clay
Alfisols					
Hyderabad	5.29	0.07	0.36	32.6	Sandy clay loam
Ranchi	6.20	0.09	0.28	25.0	Sandy clay loam
Bangalore	5.30	0.06	0.32	36.6	Sandy clay loam

applied N level, these chemicals not only increased the dry matter yield of wheat by 10-15% than urea alone but their application along with the fertilizer also resulted in better N-uptake and apparent N-recovery (%). Compared to 11.38g in control and 20.41 g in urea alone, three of the urea plus test regulator treatments gave 25-26 g of the dry matter. In comparison the dry matter yield of wheat in urea plus dicyandiamide, the reference nitrification regulator treatment was 24.55 g pot^{-1}. The application of these chemicals, at the experimental level, was not detrimental to the soil health. It is evident from the fact that values for physico-chemical properties of the experimental soil prior to sowing were comparable to these obtained after harvest of the wheat crop. The studies also indicated that use of these nitrification regulators retard the conversion of ammoniacal-N to nitrate-N without accumulation of nitrite-N, which is supposed to be toxic to the plant health.

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Sulphur Fractions and their Relationships with Soil Properties in Different Soil Types of Major Pulse Growing Regions of India

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Sulphur deficiency in soils is usually a key factor for poor yields of pulses in many soils, as poor S uptake retards the synthesis of proteins and S containing amino acids. Its deficiency in Indian soils is widespread, and its availability depends on climate, vegetation, parent materials, soil texture and management practices. Present study was undertaken to evaluate different fractions of S and their association with soil properties in 10 profiles representing different soil types of major pulse growing regions of India. Ten profiles samples – 4 representing Inceptisols (Kanpur, Faizabad, Delhi and Varanasi), 3 Vertisols (Sehore, Raipur and Gulbarga) and 3 belonging to Alfisols (Hyderabad, Ranchi and Bangalore) were collected. Different fractions of sulphur were extracted by following standard procedures and determined by the turibidimetric procedure.

Despite continuous pulse cultivation, soils were low in organic carbon content. Total S ranged from 240 to 376 mg kg^{-1}, organic S from 191 to 362 mg kg^{-1}, adsorbed S from 12.9 to 59.0 mg kg^{-1}, and available S from 3.47 to 9.22 mg kg^{-1}. Larger organic and total sulphur were observed in Vertisols, followed by Inceptisols and Alfisols, whereas adsorbed S was the highest in Alfisols. Organic sulphur constituted 81 to 95 per cent of total S. Organic carbon and EC showed positive correlation whereas pH and $CaCO_3$ showed negative correlation with different S fractions in most of the soil profiles. Results suggest that sulphur fractions in pulse growing soils are mostly governed by their organic carbon content. Available S content was low to medium, and, therefore, sulphur application is essential for increasing productivity of pulse crops.