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Potassium nutrition of rice as influenced by long term use of fertilizers in *Inceptisol*

H.K. SENAPATI, A.K. DASH, G.H. SANTRA AND B. MOHANTY

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See end of the article for authors' affiliations

Correspondence to :

H.K. SENAPATI
Department of Soil Science and Agricultural Chemistry, Orissa University of Agriculture and Technology, BHUBANESWAR (ORISSA) INDIA

ABSTRACT

The long term fertilizer experiment was designed in *Aeric Haplaquept* of Bhubaneswar, Orissa with rice-rice cropping system. The treatments comprised of 100% N, NP, NPK (with and without S, Zn, FYM and Weedcide) 50 % and 150 % NPK along with control (no fertilizer) and an additional treatments receiving lime+NPK (based on soil test). In the preceding years substantial yield reductions of *kharif* rice were observed in the treatment receiving either to K or low rates of K application. Moreover, K balance sheet was found to be negative in all the treatments. In spite of negative K balance there was gain of NH_4OAC extractable K from 10 to 30 kg ha^{-1} and loss of non exchangeable K from 17 to 121 kg ha^{-1} in all the treatments over initial value. Equilibrium activity ratio (AR Ke) was found to be the lowest 1.2 x 10^{-3} $(M/l)^{1/2}$ in 100 % NP and highest (3.2 x 10^{-3} $(M/L)^{1/2}$ in 150 % NPK treatment. Potential building capacity (PBC^{-K}) was highest in the treatment receiving lime + NPK (soil test). Labile K (-DKe) was lowest (2.2 x 10^{-2} meq/100 g) in 100 % NP treatment as against 3.4 x 10^{-2} meq/100 g in the treatments receiving lime + NPK (soil test). K/N ratio of plant was much lower at the PI stage and also decreased with increasing levels of NPK which showed that K availability was not in proportion to availability of N. K/Fe ratio increased 2 to 3 fold and there was also increase of Mn/Fe ratio of PI stage with increasing levels of K. Variations in K content in plant were found to be significantly related to the variation in equilibrium concentration of K, ARKe, NH_4 OAC-K and HNO_3-K.Fe content in plant decreased with increasing levels of K application. Yields were significantly higher with higher levels of K.

Key words : Long term fertilizer use, K nutrition, Rice-rice cropping system, Rice yield

Potassium (K) in the plant nutrient is very much important since it activates a number of enzymes, involved in metabolism of carbohydrates, protein, membrane permeability, stomatal regulation, water and nitrogen utilization, improves utilization of sunlight during cool and cloudy periods, resistance to pests, diseases and stresses created by drought, frost, salinity etc. and improves crop quality. Crop removal of K often exceeds annual addition (Duxbury *et al*., 2000). The non-exchangeable K is the major contributing form of K to total K uptake by the crops, which signifies that non-exchangeable K in soils can be used to predict and ascertain the long term K supplying power of soils when levels of available K decreases below a certain minimum level (Benipal *et al*., 2004).The magnitude of all the forms of K decreased with depth, irrespective of the treatments (Lal *et al*., 2001). AR K_e alone is better correlated with the amount of potassium derived from exchangeable form and AR^K_e together with the quantity of K released (DK^0) is an index of total K uptake. The potential buffering capacity (PBC^K) is related to the amount of K released from non exchangeable source and correlated with the clay content and degree of K fixation in soil (Acquaye and Maclean, 1966).

MATERIALS AND METHODS

The ongoing long term fertilizer experiment at Orissa University of Agriculture and Technology, Central Research Station (Since 1971-72) on a sandy loam soil (Aerie Haplaquept) was undertaken for this investigation. The initial soil of the field plots recorded 0.27 % organic carbon and 150, 31, 25 and 22 kg ha^{-1} of available N, P, K and S, respectively. The DTPA available Zn, Fe, Mn and Cu were 1.44, 52.80, 7.80 and 1.40 ppm, respectively. The treatments were T_1: 50 % NPK, T_2: 100 % NPK (weedicide), T_3: 150 % NPK, T_4 : 100 % NPK, T_5 : 100 % NPK + Zn, T_6 : 100 NP, T_7: 100 % N, T_8: 100 % NPK + FYM, T_9: 100% NPK (S), T_{10}: 100 % NK/soil tst based. T_{11}: control. The recommended dose (*i.e.*, 100 % NPK) was 100, 60 and 60 kg of N, P_2O_5 and K_2O ha^{-1}, respectively. 100 % NK was up to 1981-82 and soil test based fertilizer dose from 1981-82 *rabi*.

After the 16th cropping cycle (*kharif*) rice cultivar Jaya was taken as the test crop. For the present investigation, plant samples were collected at the maximum tillering stage (40 days after transplanting) and panicle initiations stage (60 days after transplanting) for determination of the nutrient content in the dry matter. Equilibrium soil extract was collected and preserved to determine the concentration of K, Fe and Mn. The same soil sample was used for the Q1 studies. Processed soil samples (< 2 mm) were used for estimation of 1-N