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EXPLOITATION OF POTASSIUM FRACTIONS BY WETLAND RICE FERTILIZED WITH NITROGEN AND PHOSPHORUS

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A greenhouse experiment was conducted lo elucidate the influence of Nand P fertilisation on various soil K fractions andto investigate yield and plant uptake of K in rice. Application of 100 kg N ha^{-1} significantly ($P < 0.05$) increased number of tillers, plant height, straw yield and grain yield. Without P, application of 200 kg N ha^{-1} significantly ($P<0.05$) depressed plant height, straw yield and grain yield and increased sterility. Maximum grain and straw yield and plant height was noted for 100 and 50 kg ha^{-1} Nand P, respectively. Potassium concentration in plants decreased by 40% at higher levels of 200 kg N ha^{-1} and 100 kg P ha-I. Following N and P fertilisation, initial level of 17 mg kg^{-1} soluble and 67 mg kg-I slowly available K decreased to 8 to 11 and 28 to 52 mg kg-I, respectively. Post-harvest exchangeable K in soil ranged from 38 to 42 mg kg-I.

INTRODUCTION

Omitting potash from fertiliser rcc-ommendation is attributed to K (14 to 34 kg ha-I) added with irrigation water (Malik *et al.,* 1989) and to reserve K in micaceous minerals common to wide areas of cultivated land in Pakistan (Bajwa, 1989). However, in coarse textured soils and in areas where there has been an intensive history of Nand P fertilisation, K may become a major limiting element in crop production (Nabhan *et al., 1989).*

Flooding soil for rice cultivation commonly yields anaerobic soil conditions which can impart an entirely different consequence on various soil chemical equilibria. Loss of available K by leaching, accentuated by potash fixation following alternate wetting and drying of the soil changes K concentralion in soil labile pool (De Datta and Mikkelsen, 1985). Polassium in solution should be replenished lo avoid its deficiency (Mengel, 1982; Mengel and Busch, 1982), The present greenhouse experiment was designed lo elucidate the influence of Nand P fertiliser application on various forms of soil K as well as to investigate yield and plant uptake of K in rice.

MATERIALS AND METHODS

A bulk surface (Ap horizon) soil sample collected from experimental farm of National Agricultural Research Centre, Islamabad was air dried and ground to pass through a 2 mm sieve. The soil had loam texture (clay 11.6%, silt 34.4% and sand 51.0%), pH 7.8, EC_e 0.8 dS m-I and CEC 5.5 me 100 g-I (Black, 1%5). Water soluble, exchangeable and slowly available (HNO_3 extractable) K was 17, 30 and 67 mg kg-I, respectively. Fifteen kg portion of air dried sicvcd soil was placed in each glazed pot and fertilised according lo trcalmcnts: Tj-control; TrlOO kg N ha-I; Tr200 kg N ha-I; T_4-100:50 N:P kg ha-I; Ts-lOO:lOO N:P kg ha-I and T6-200:100 N:P kg ha^{-1}. Urea and

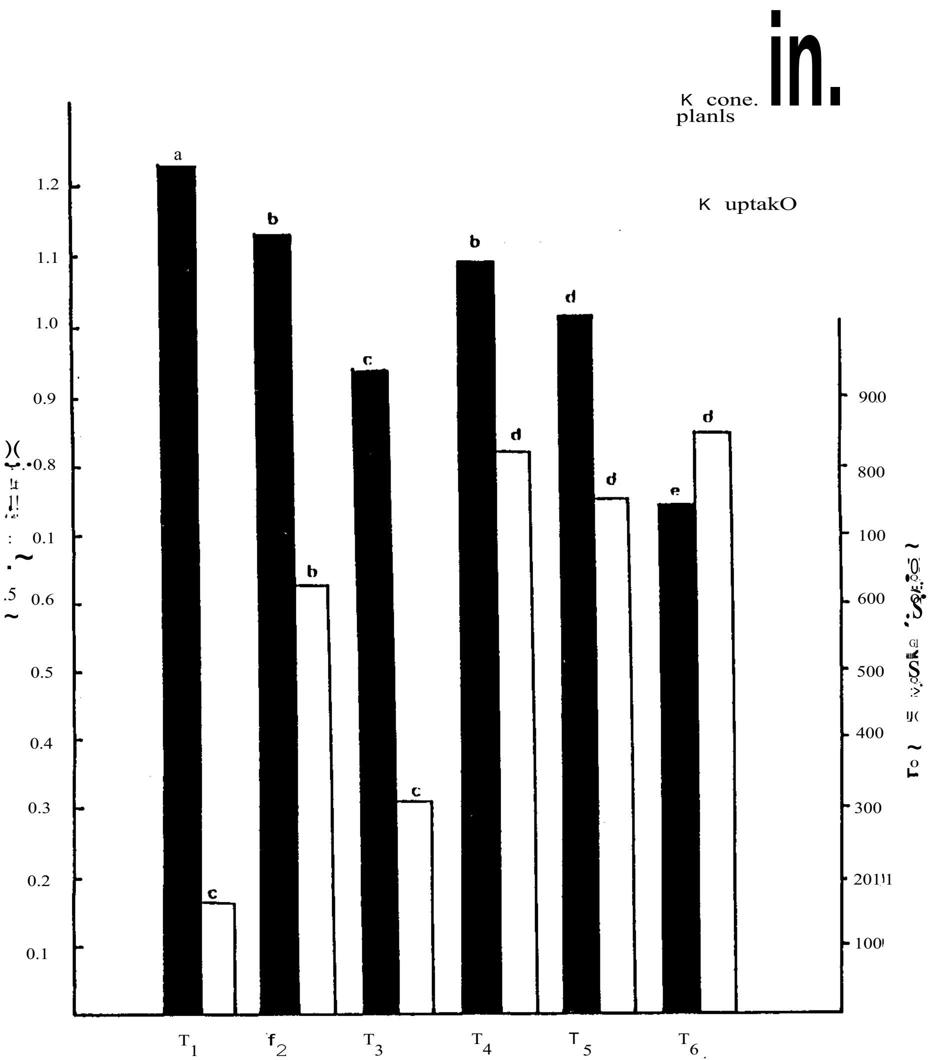

Fig. 1. Effect of different treatments on K concentration and uptake by rice plants.

single superphosphate were used to impose treatments in quadruplicate according to completely randomised design. Pots were puddlcd and maintained in flooded conditions throughout the experiment with tap water containing an average concentration of 3 ppm K. Three-week old six seedlings of rice (Basmati-370) were transplanted and maintained per poL. Harvested above ground plant portions were oven dried to a constant weight for their dry matter yield and were analysed for K uptake after digestion with HNO_3-$HClO_4$ diacid mixture. Post-harvest soil samples collected from all the pots were analysed for water soluble, exchangeable and slowly available K in soil. All data were subjected to analysis of variance. Duncan's multiple range test was used for mean separation among the treatments (Steel and Torrie, 1980).

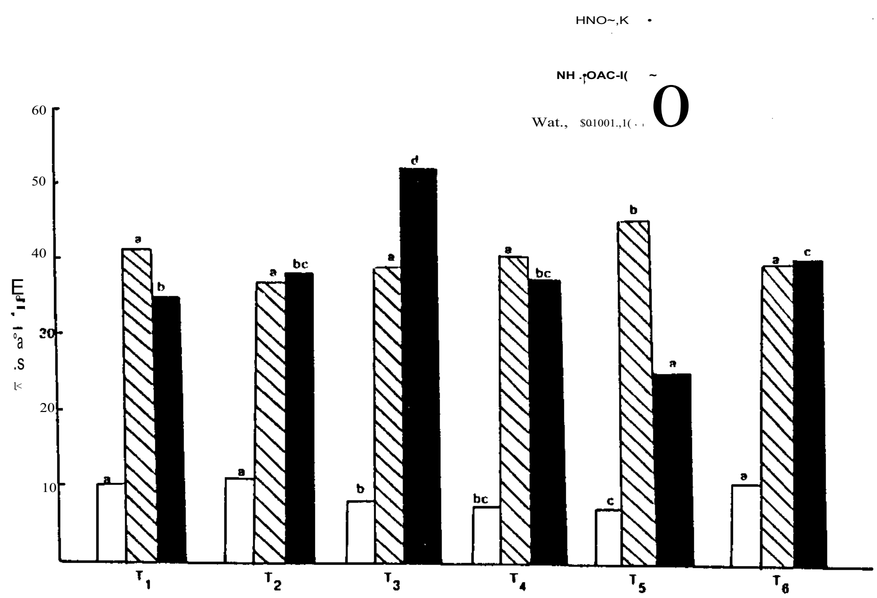

Fig. 2. Post, harvest status of different forms of potassium in soil.

RESULTS AND DISCUSSION

Plant growth: Application of N either alone @ 100 or 200 kg ha^{-1} or in combination with 50 and 100 kg P ha^{-1} significantly (P<0.05) increased plant height, number of tillers, straw yield and grain yield of Basmati-370 rice (Table 1). Without P application, the high level of N fertiliser (200 kg N ha^{-1}) depressed all the observed yield components and increased per cent sterility. Application of 100 kg N ha^{-1} with either level of P significantly (P < 0.05) produced maximum plant height, number of tillers per plant, and grain and straw yield. The per cent sterility was also decreased. On the other hand application of 200 kg N ha^{-1} with 100 kg P ha^{-1} had inconsistent effects on various yield parameters but increased per cent sterility.

Potassium in plants in relation to soil K fractions: Without P application increasing N fertiliser decreased K concentration in plants but tended to increase total K uptake (Fig. 1). In the presence of applied N and P fertilisers, plant K uptake was significantly (P<0.05) increased though the K concentration in plants decreased to less than 1.23% which suggested a dilution effect associated with dry matter accumulation. Minimum concentration of K (0.74%) in plants was observed when N and P were applied @ 200 and 100 kg ha^{-1}, respectively.

Flooding for rice cultivation, in general, imparts a significant influence on soil physico-chemical properties with a vital impact on mineral nutrition of rice plants. Dissolution and reduction of Fe and Mn under reduced soil situation improves labile

Table 1. Effect of different NP fertiliser treatments on various yield parameters of rice Basmati-370

S. No.	Treatment	Plant height (cm)	Grain yield	Straw yield	Tillers per plant	Sterility (%)
			(g/ pot)			
T1	Control	104.2 c	21.8 a	13.45 e	2.12 d	59.0
T2	100-0-0	129.0 a	86.9 b	56.12 c	3.58 c	68.0
T3	200-0-0	114.9 b	43.6c	33.5 b	3.79 c	100.0
T4	100-50-0	129.9 a	185.8 d	74.9 d	6.08 b	17.4
T5	100-100-0	130.9 a	178.8 d	73.9 d	5.62 b	22.8
T6	200-100-0	136.0 a	79.4 b	114.6 a	7.70 a	81.6

soil K through exchange processes (De Dalta and Mikkelsen, 1985). In present investigation forms of soil K were also influenced by the application of Nand P fertilisers. When compared to its pro-cropping status of 17 mg kg-I, water soluble K in soil under various treatments ranged from 8 to 11 mg kg-I (Fig. 2). Post-harvest exchangeable K in soil was 38 to 42 mg kg-I compared to 37 mg kg-I exchangeable K estimated for the original soil. Decreased from its initial status of 67 iUg kg-I to 28 to 32 mg kg-I of slowly available K suggests a rapid replenishment of labile K in soil. A 40% decrease over the control in K concentration was observed in plants receiving Nand P @ 200 and 100 kg ha-I, respectively. These observations warrant further investigations especially under field condition to determine their significance and possible implications on K fertilisation in the presence of regularly applied Nand P fertilisers.

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