Effect of sulphur nutrition on the content and uptake of nitrogen, phosphorus and sulphur by rice (Oryza sativa L.) in rice-rice cropping sequence in vertisol of Karnataka

D.N. SAMARAWEERA, H.T. CHANNAL, B.I. BIDARI AND M. HEBBARA

ABSTRACT
Field experiments were conducted during Rabi/summer and Kharif seasons of 2007 at Agriculture Research Station, Gangavati (Dist. Koppal) to study the direct and residual effect of sulphur on N, P and S uptake by rice (Cv. IR-64). The results obtained in first rice crop revealed that the treatment receiving RDF + FYM (10 t/ha) + ZnSO$_4$ (20 kg/ha) + 50.0 kg sulphur ha$^{-1}$ (factomphos) registered the highest grain and straw N contents (1.33 and 0.97%), P content (0.294 and 0.144%), S content (0.235 and 0.207%) and their uptakes (65.29 and 53.08 kg ha$^{-1}$), (14.43 and 7.88 kg ha$^{-1}$) and (11.54 and 11.33 kg ha$^{-1}$), respectively. In succeeding rice, the same treatment recorded the highest grain and straw N contents (1.32 and 0.96%), P (0.285 and 0.130%), S contents (0.240 and 0.214%) and their uptakes (58.92 and 47.90 kg ha$^{-1}$), (12.72 and 6.49 kg ha$^{-1}$) and (10.76 and 10.22 kg ha$^{-1}$), respectively.

Key words : Sulphur nutrition, Factomphos, Uptake, Straw and grain.

INTRODUCTION
Sulphur is the fourth major nutrient after nitrogen, phosphorus and potassium. At present sulphur deficiency in soils of various Indian states varies from 5 to 83% with an overall mean of 41% (Singh, 2001). Sulphur in Indian agriculture is now gaining added importance because of the recognition of its role in increasing crop production not only in oil seeds, pulses, legumes and forages but also in many cereals. The importance of sulphur nutrition is increasingly felt in enhancing the productivity of cereal crops, specially with the advent of high yielding rice varieties under intensive cropping systems and the use of high doses of high analysis fertilizers viz., urea, diammonium phosphate and muriate of potash. Therefore, the present study was carried out to study the direct and residual response of irrigated rice to applied sulphur, where traditional fertilizers like single super phosphate and ammonium sulphate etc. are getting replaced by urea and diammonium phosphate.

MATERIALS AND METHODS
Field experiments were conducted at Agriculture Research Station, Gangavati, UAS, Dharwad during Rabi/summer and Kharif seasons of 2007 to investigate the direct and residual effect of applied sulphur on changes in N, P and S contents in grain and straw of rice (cv. IR-64). Composite soil sample (0-20 cm) was collected from experimental site before start of the experiment and analyzed for physical and chemical characteristics by employing standard methods. The experimental soil was medium black, had organic carbon : 4.78 g kg$^{-1}$, EC : 0.18 dS m$^{-1}$ and pH : 8.12. The available N, P, K and S
were 172.3, 14.9, 179.8 and 11.2 kg ha$^{-1}$, respectively. The DTPA extractable micronutrients were 0.58, 2.68, 7.67 and 9.85 mg kg$^{-1}$ of Zn, Cu, Fe and Mn, respectively. The experiment was laid out in a randomized block design (RBD) with three replications and eight treatments. Treatments include $T_1$: RDF, $T_2$: RDF + FYM (10 t/ha) + ZnSO$_4$ (20 kg/ha), $T_3$: $T_2$ + 25.0 kg sulphur ha$^{-1}$ (factomphos), $T_4$: $T_2$ + 37.5 kg sulphur ha$^{-1}$ (factomphos), $T_5$: $T_2$ + 50.0 kg sulphur ha$^{-1}$ (factomphos), $T_6$: $T_2$ + 25.0 kg sulphur ha$^{-1}$ (gypsum), $T_7$: $T_2$ + 37.5 kg sulphur ha$^{-1}$ (gypsum) and $T_8$: $T_2$ + 50.0 kg sulphur ha$^{-1}$ (gypsum). A common dose (RDF) of 150 kg N, 75 kg P$_2$O$_5$ and 75 kg K$_2$O was given for all treatments using Urea, diammonium phosphate and factomphos wherever necessary. The entire amount of P$_2$O$_5$ and K$_2$O and half dose of N were applied at transplanting. The remaining N was applied in two equal splits, first at tillering and second at panicle initiation stage. One month old seedlings of rice (cv. IR-64) were transplanted at the rate of 2-3 seedlings per hill with a spacing of 20 x 10 cm. Irrigation (3-5 cm standing water) was given and water was drained from the field 15 days before harvesting. After harvest of first crop, field was kept undisturbed and residual crop (cv. IR-64) was raised. The residual crop did not receive S, but received FYM according to treatments and RDF applied through urea, DAP and MOP. Grain and straw were analyzed for N, P and S contents by employing standard methods and uptake was worked out. All data recorded were statistically analyzed by the technique of analysis of variance and CD values were computed at 5% level of significance.

**RESULTS AND DISCUSSION**

The results obtained from the present investigation are presented in Table 1 and 2:

**Concentration of N, P and S:**

The influence of sulphur on N, P and S contents in grain and straw over $T_1$ treatment (RDF alone) was significant in both first and residual rice (Table 1). In first rice crop, the highest grain and straw N (1.33 and 0.97%), P (0.294 and 0.144%) and S (0.235 and 0.207%) contents were noticed with the application of $T_5$ treatment [RDF + FYM (10 t/ha) + ZnSO$_4$ (20 kg/ha) + 50.0 kg sulphur ha$^{-1}$ (factomphos)]. In grain and straw, N content registered by $T_4$ treatment [RDF + FYM (10 t/ha) + ZnSO$_4$ (20 kg/ha) + 37.5 kg sulphur ha$^{-1}$ (factomphos) (1.28 and 0.92%) was at par with $T_5$ treatment. In grain, P content (0.287%) recorded by $T_4$ was at par with $T_5$. Similarly, S content in grain and straw registered by $T_4$ treatment (0.223 and 0.194%) was at par with $T_5$. 

D.N. SAMARWEERA, H.T. CHANNAL, B.I. BIDARI AND M. HEBBARA
(22.5 and 41.2%) and S contents (79.4 and 68.3%) recorded by T5 treatment was significant over T1 treatment (RDF alone) in grain and straw, respectively.

In succeeding rice, the highest grain and straw N (1.32 and 0.96%), P (0.285 and 0.130%) and S (0.240 and 0.214%) was noticed with T5 treatment [RDF + FYM (10 t/ha) + ZnSO4 (20 kg/ha) + 50.0 kg sulphur ha⁻¹ (factomphos)]. In grain and straw, N content (1.31 and 0.93%) registered by T8 treatment [RDF + FYM (10 t/ha) + ZnSO4 (20 kg/ha) + 50.0 kg sulphur ha⁻¹ (gypsum)] N and T4 treatment (1.27 and 0.90%) was at par with T5 treatment. In grain and straw, P content recorded by T8 treatment (0.280 and 0.126%), T4 treatment (0.276 and 0.124%) and T7 treatment (0.273 and 0.121%) were at par with T5. Sulphur content in grain and straw recorded by T8 treatment (0.224 and 0.201%) and T4 treatment (0.219 and 0.195%) were at par with T5. The highest increase in N content (21.1 and 28.0%), P (22.8 and 28.7%) and S contents (96.7 and 94.5%) were recorded in T5 treatment over T1 treatment (RDF alone) in grain and straw, respectively. The increase in N, P and S contents might be due to the role of sulphur in growth, development and chlorophyll formation resulting in its higher utilization. Similar results were noticed for N content by Tiwari et al. (1983), Singh et al. (1994), Jena et al. (2006), P content by Aulakh et al. (1980), Sachdev et al. (1982), S content by Singh et al. (1993), Ram et al. (1999) and Sriramachandrasekharan et al. (2007).

**Uptake of N, P and S:**

The uptake of N, P and S in grain and straw was significant over T1 treatment (RDF alone) in both first and succeeding rice crops. In first rice crop, the highest grain and straw N uptake (65.29 and 53.08 kg ha⁻¹), P uptake (14.43 and 7.88 kg ha⁻¹) and S uptake (11.54 and 11.33 kg ha⁻¹) were noticed in T5 treatment [RDF + FYM (10 t/ha) + ZnSO4 (20 kg/ha) + 50.0 kg sulphur ha⁻¹ (factomphos)]. Grain and straw N uptake recorded by T4 treatment (60.76 and 48.76 kg ha⁻¹) was at par with T5 treatment. In grain, uptake of P in T4 treatment (13.62 kg ha⁻¹) was at par with T5 while P uptake by straw in treatment T4 was superior over rest of the treatments. Sulphur uptake registered by T4 treatment in both grain and straw (10.59 and 10.28 kg ha⁻¹) was at par with T5. With respect to uptake values in grain and straw, the highest increase of N uptake (53.3 and 62.7%), P (56.7 and 79.9%) and S (129.4 and 114.5%) recorded by T5 treatment was significantly superior over T1 treatment (RDF alone) in both grain and straw, respectively (Table 2).
highest grain and straw N uptake (58.92 and 47.90 kg ha\(^{-1}\)), P uptake (12.72 and 6.49 kg ha\(^{-1}\)) as well as S uptake (10.76 and 10.22 kg ha\(^{-1}\)) and was superior over T\(_1\) treatment (RDF alone). Uptake of grain N recorded by T\(_8\) (56.36 kg ha\(^{-1}\)) and T\(_4\) (54.61 kg ha\(^{-1}\)) treatments was at par with T\(_5\) treatment. N uptake by straw in treatment T\(_8\) (45.48 kg ha\(^{-1}\)) was at par with T\(_5\) treatment. The grain and straw uptake of phosphorus registered in T\(_8\) (12.05 and 6.16 kg ha\(^{-1}\)) and T\(_4\) treatments (11.87 and 5.97 kg ha\(^{-1}\)) were at par with T\(_5\) treatment. Similarly, Uptake of sulphur by grain recorded in T\(_8\) (9.88 kg ha\(^{-1}\)) and T\(_4\) (9.55 kg ha\(^{-1}\)) treatments were at par with T\(_5\) treatment. In straw, T\(_8\) (9.51 kg ha\(^{-1}\)) treatment was at par with T\(_5\). With respect to uptake by grain and straw, the highest increase of N (57.1 and 61.3%), P (59.3 and 62.2%) and S uptake (145.1 and 155.1%) were recorded in T\(_5\) treatment over T\(_1\) (RDF alone) in both grain and straw respectively. Sriramachandrsekharan et al. (2007) in their study reported that the increase in sulphur uptake in first rice crop (67.3% in grain and 69.7% in straw) and in succeeding crop (202.7% in grain and 110.4% in straw) was due to direct effect of sulphur applied at the level of 60 kg ha\(^{-1}\). The results of the study are in consonance with the findings of Patnaik and Sathe, (1993) and Jena et al. (2006) and Oo et al. (2007).

REFERENCES


********
******