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AVAILABILITY OF SILICON, YIELD AND UPTAKE BY RICE AS INFLUENCED BY SILICATE MATERIALS WITH FYM IN MADUKKUR SOIL SERIES

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ABSTRACT

Field experiment conducted to study the effect of various silicate materials with or without FYM on availability of Si, yield, Si content and uptake by rice in Madukkur soil series revealed that addition of FYM at 25 t/ha and silicate materials at 1.0 t/ha increased available Si in soil and crop yield. The Si content was higher in straw than in rice grain.

Key words: Availability of silicon, Rice yield, Silicate materials.

Silicon is one of the most dominant elements in the ash of plants especially cereals. Rice shows the largest uptake of Si among the cereals (Vorm, 1980). The amount of silicon available to plants in soil is relatively very small and varies among soils. Increase in the concentration of silicon in the solution with organic matter content of soil has been reported earlier by Ponnamperuma (1964). However, the influence of addition of organic matter on the availability of Si has not yet been studied in detail so far. Addition of silicate materials to the soil increases the available Si (Park, 1973). Studies on the efficiency of various silicate materials such as sodium meta silicate, furnace slag and rice husk on equal silica content basis in improving the rice yield are sporadic in India. Keeping all these aspects in view, a study was carried out to find out the effect of various silicate materials viz., sodium meta silicate, furnace slag and rice husk with or without FYM on availability of Si, yield, content and uptake of Si by rice in Madukkur series.

MATERIALS AND METHODS

The field experiment was carried at Central Farm of Agricultural College and Research Institute, Madurai. The soil of experimental site was a sandy clay loam with 7.70 pH (1:2), 0.25 m.mhos/cm EC and 0.72 % organic carbon and is classified under Madukkur series. The available Si content in soil was 55.4 ppm. The experiment was laid out in split plot design and two levels of FYM at 0 and 25 t/ha in main plots and various sources of silicate materials at 1 t SiO_2/ha in the sub plots with IR 50 rice as test crop. Silicate materials were powdered to pass through 100 mesh sieve and applied basally. One half of the recommended dose of N ie., 50 kg N/ha as urea and entire dose of 50 kg P_2O_5/ha as superphosphate and 50 kg K_2O/ha as muriate of potash were applied basally. The remaining quantity of N ie., 50 kg N/ha was applied as urea in two splits, one at tillering and the other at panicle initiation stages.

The soil and plant samples (0-20 cm) collected at tillering, panicle initiation, flowering and at harvest stages were evaluated for available silicon by using N, NaOAc, pH 4.0 (Hallmark *et al.*, 1982) and Nayar *et al.* (1975). The uptake of Si was computed.

RESULTS AND DISCUSSION

Availability of silicon

Increase in Si content was observed due to added FYM (25 t/ha) at all the stages of crop growth. The organic acids produced during the

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Table 1.Influence of silicate materials with/without FYM on available silicon and yield of rice

Treatments	Available Silicon (kg/ha)				Yield (kg/ha)	
	Tillering	Panicle Initiation	Flowering	Post harvest	Grain	Straw
Silicate materials						
Control	151.3	135.8	118.3	81.9	3332	5666
Sodium meta silicate	274.2	252.1	211.8	193.0	3641	5883
Furnace slag	294.4	271.9	223.8	206.8	3802	6183
Rice husk	306.3	275.6	238.4	222.4	3847	6330
CD (P=0.05)	7.7	5.3	3.8	3.3	186	289
No FYM	249.2	227.9	193.6	172.2	3445	5708
FYM	263.8	239.7	202.6	179.9	3865	6323
CD (P=0.05)	7.0	9.5	4.1	2.1	98	260

decomposition of organic matter might have solubilised more silica with added FYM. Similar view has been expressed by Ponnamperuma (1964) and Yamane and Okayaki (1982). Addition of silicate materials increased availability of Si in soil at all stages of crop growth. The increase in available Si can be attributed to the addition of silicate materials which might have contributed for more release of soluble Si to the soil. Similar trend was reported earlier by Chinnaswamy and Chandrasekaran (1976) and Patrick and Reddy (1978).

The available Si content in soil was found to be maximum at tillering and then gradually decreased with advancement of crop growth. This might be due to crop removal and also due to the recombination of Si with alumino silicates. This is in confirmation with the results reported by Takahashi (1968) and Ponnamperuma (1972).

Yield of rice

The increase in grain and straw yield was 12.3% and 10.8% respectively over that of control due to the addition of FYM (Table 1). Besides supplying plant nutrients FYM increased the availability of nutrients like Si in soil and Si content in the plant causing more rice yield. Addition of silicate materials increased both grain and straw yields. This can be attributed to the greater amount of silica in plant which enables the tillers to be more erect, providing more exposure to sun light and resulting in efficient assimilation of nutrients (Yoshida *et al.*, 1969).

Si content

Treatments with FYM had higher Si content at all the stages. This might be due to increase in the availability of Si by solubilization of aluminosilicates by FYM addition. Application of silicate materials significantly increased Si content of plant at all the stages of crop growth. Among the silicate materials, rice husk was found to be superior than the others. The increased availability of Si in soils due to the addition of silicate materials might have been the reason for higher Si content. Similar view was expressed earlier by Zang and Zhang (1982).

Silicon content in plant increased with advancement of crop growth. This could be attributed to the uptake of Si by the plant continuously. Si content in straw was higher than in the grain. The silicon is deposited in the epidermal cells and cell walls of the rice plant in the form of silica gel. Silica gel in the rice plant is immobile and does not act as a source of silicon supply for other parts of the plant, thereby causing higher Si content in straw (Yoshida *et al.*, 1962).

Table 2. Influence of silicate materials with/without FYM on silicon content and uptake by rice

Treatments	Si content (%)					Si uptake (kg/ha)					
	Tillering	Panicle Initiation	Flowering	Grain	Straw	Tillering	Panicle Initiation	Flowering	Grain	Straw	Total
Silicate materials											
Control	1.67	2.22	2.86	1.66	3.14	24.0	137.4	228.6	55.4	178.8	233.1
Sodium meta silicate	1.82	2.83	3.05	1.87	3.44	30.2	181.3	251.9	68.3	202.6	272.7
Furnace slag	1.87	3.02	3.22	2.11	3.52	31.6	214.1	280.0	80.4	222.2	303.5
Rice husk	1.94	3.12	3.40	2.17	3.60	36.8	247.6	307.3	83.9	228.7	313.6
CD (P=0.05)	0.05	0.09	0.09	0.03	0.05	1.8	13.0	21.1	3.8	11.0	13.7
FYM											
No FYM	1.78	2.69	3.02	1.91	3.32	28.3	176.9	245.5	66.2	192.0	259.0
FYM	1.87	2.90	3.23	2.00	3.52	33.0	213.2	288.4	77.8	223.6	301.1
CD (P=0.05)	0.06	0.05	0.03	0.03	0.05	0.7	7.4	29.1	2.9	15.7	17.2

Si uptake by rice

Significant increase in Si uptake was observed due to added FYM. All the silicate materials were found to increase the uptake of Si. Since the treatments registered identical influence on the concentration of Si and yield of dry matter, such a result could be expected. The reasons attributed earlier for the findings may hold good for this observation also. Increase in SI uptake by added silicate slag and rice husk was also reported by Lee (1983). The Si uptake in plant increased with increase in plant growth. Si uptake in straw was higher than in the grain. This might be due to the immobility of silicon in plant and accumulation in the leaf itself.

REFERENCE

CHINNASWAMY, K.N. and CHANDRASEKARAN, S. 1976. Effect of silicagel on rice in three soil types. *Annamalai University Agri. Res. Ann.*, **6**: 13-29.

HALLMARK, C.T., WILDING, L.P. and SMECK, N.E.. 1982. Silicon. In: Part 2 Chemical and Microbiological properties - Methods of Soil Analysis, pp.263-273. Ed. Page A.L. 2 nd Edn. Agronomy Monograph No.9 American Society of Agronomy, Maxdison, Wiscosin, U.S.A.

LEE, T.S. 1983. Improvement of latosolic paddy fertility. *Soils Fert.*, Taiwan, 1-20.

NAYAR, P.K., MISRA, A.K. and Patnaik, S. 1975. Rapid micro determination of silicon in rice plant. *Pl. Soil.* **42**: 491-494.

PARK, C.S. 1973. The use of silicon in Korean agriculture. ASPAC. Food and Fertilizer Technology Centre, *Ext. Bull.*, **35**: 3-9.

PATRICK, JR., W.H. and Reddy, C.N. 1978. Chemical changes in rice soils. Soils and Rice, pp. 361-379. Int. Rice Res. Instt., Los Banos, Philipines.

PONNAMPERUMA, F.N. 1964. Dynamic aspects of flooded soils and nutrition of the rice plant. In: The Mineral Nutrition of the Rice plant, P.295-328. Symp. Intern. Rice Res. Inst. Johns Hopkins Press, Baltimore, Maryland.

PONNAMPERUMA, F.N. 1972. The chemistry of submerged soils. *Adv. Agron.*, **24**: 29-96.

TAKAHASHI, E. 1968. Silica as a nutrient to the rice plant. *JARQ*, 3: 1-4.

VORM, P.D., VANDER. J. 1980. Uptake of Si by five plant species as influenced by variations in Si supply. *Pl. Soil.*, **56**: 153-156.

YAMANE, I. and OKAYAKI, M. 1982. Chemical properties of submerged rice soils. Symp. Paper Vertisols and rice soils of the tropics. *P. 152. 12th Int. Cong. Soil Sci.*, New Delhi.

YOSHIDA, S., ONNISHI, Y. and KITAGISHI, V. 1962. Chemical forms, Mobility and deposition of silicon in rice plant. *Soil Sci. Pl.Nutr.*, **8** : 107-113.

YOSHIDA, S., NAVASERO, S.A. and RAMIREZ, E.A. 1969. Effects of silica and nitrogen supply on some leaf characters of the rice plant. *Pl. Soil.*, **31**: 48-56.

ZANG, H.L. and ZHANG, K.P. 1982. On the silicon supplyinig capacity of some important paddy soils in South China. In: First International Symposium on soil, Geology and land forms-Impact on land use planning in developing countries, pp. A9-a A9-7 Ed/ Nutalaya, P.*et al*. Bangkok, Tailand.