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Studies on Silicate Nutrition of Rice in the Laterite Soil of Kerala*

I. Effect on growth and yield

by

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Introduction: The major portion of cultivated area of Kerala State has laterite and lateritic types of soil which are acidic in nature and are low in productivity. When H-ion concentration exceeds a certain limit, free water soluble silica is formed. This gets leached away leaving an abundance of sesquioxide to form a soil of low productivity. The application of silicon to such soil would enhance its production potential. The problem has not been studied in great detail and the present investigation was undertaken to fill this lacuna to some extent.

Review of Literature: Liebig (1840) was perhaps the first to show that silicon is a necessary element in plant nutrition. This was followed by the work of Wolff and Kreuzhage (1884), who observed increased grain yield in oats. Lemmerman and Weisman (1922) noted that the greater the amount of silicic acid available, the greater was the crop yield, the marked increase being in fields deficient in phosphorous. Ishibhashi (1937) found that the yield of grain and straw of rice was increased by adding silicic acid. Srinivasan (1938) obtained best results when silica was applied in instalments to rice crop. Bastisse (1946) obtained three-fold increase of corn in alkali soils and five-fold increase in neutral soils treated with silica. Hosoda and Takota (1957) recorded 14 per cent increased yield in rice on application of calcium silicates in soils of low SiO_2 / Al_2O_3 ratio. Tahahashi (1961) found that the absence of silicon led to decrease in the growth, number of tillers, fresh and dry weights of straw and a decrease in number of spikelets per panicle and the percentage of ripe grains. Datta *et al.* (1962) found application of sodium silicate increased the yield of wheat and rice but not of berseem. Money (1964) reported marked increase in grain yield of rice due to the application of magnesium silicate. Padmaja and Verghese (1964) observed significant increase in yields of grain and straw by the application of magnesium and silica to rice crop.

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Material and Method: A pot culture experiment with randomised design was laid out with the following treatments replicated 10 times:

Treatments: (1) NoSo, (2) NoS_1, (3) NoS_2,
(4) N_1So, (5) N_1S_1, (6) N_1S_2,
(7) N_2So, (8) N_2S_1, (9) N_2S_2.

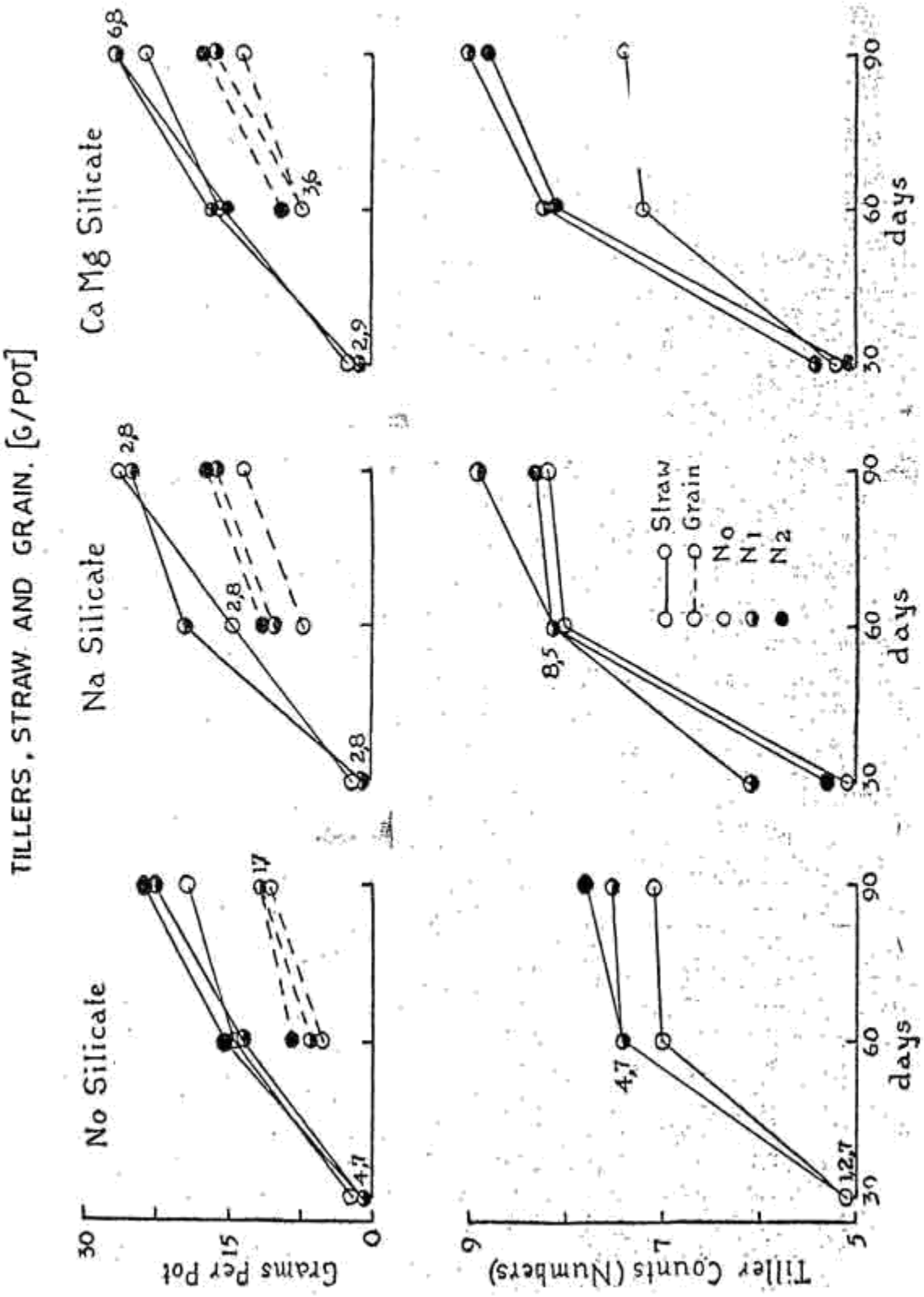
where No, N_1 and N_2 represent 30, 60 and 90 lb N per acre respectively; and So = 0 lb SiO_2 / acre, S_1 = 100 lb SiO_2 per acre as Na_2SiO_3. S_2 = 100 lb SiO_2 per acre as $CaMgSiO_3$.

Nitrogen was given as ammonium sulphate (20.5% N). Silicon was given in the form of sodium silicate (50% SiO_2) and calcium magnesium silicate (10% Ca and 15% Mg and 30% SiO_2). Superphosphate (16% water soluble P_2O_5) and muriate of potash (60% K_2O) were added to supply respectively 30 lb P_2O_5 and 30 lb K_2O per acre as a basal dressing.

The paddy soil (laterite) for the pot culture study was collected from the *Kayal* land of the Agricultural College and Research Institute, Vellayani, (Kerala). The general properties of soil are pH. 4.5; organic carbon 1.4%; C.E.C. (me / 100 g) 6.0; acid soluble silica 4.35% and water soluble silica in traces. Paddy strain used was PTB. 10. Tiller counts were recorded at monthly intervals from the date of planting. The yield of straw and roots on the 30th day and that of grain, straw and roots on the 60th and 90th day after transplanting were recorded after drying in air to constant weights separately for each pot. This is to find out the influence of the form of silicates in the important phases of rice growth.

TABLE. *Tiller Count and Yield (g / pot)*

Treatments	Tiller counts			Yield in grams per pot							
	Days			30th Day		60th Day			90th Day		
	30th	60th	90th	Root	Straw	Root	Straw	Grain	Root	Straw	Grain
1	5 0	7.0	7.1	0.34	2.34	2.00	14.06	5.39	3:70	19.17	10.72
2	5.0	8.0	8.2	0.36	1.90	1 93	14 25	7.43	4.80	26.30	13.53
3	5 2	7.2	7.4	0.36	2.60	2.95	15 50	7.36	4.86	23.40	13.50
4	5.0	7.4	7.5	0 22	1.37	1.45	13.80	6.72	4 57	22 60	11 60
5	6.1	8.1	8.9	0 31	1.40	2.18	19.43	9.85	4.84	25.83	16.13
6	5.4	8.2	9.0	0 26	1.66	2.08	15 76	7.45	4.78	26.48	16 40
7	5.0	7:4	7:8	0.27	1.47	1.44	14.83	8:82	4.35	23.05	10.73
8	5.3	8.1	8 3	0.27	1.80	1.88	14 29	11.34	5.08	25.10	16.66
9	5.0	8.1	8.8	0.40	1.81	2.69	15.20	9.07	5,10	26.40	16.56
Whether sig.	Not analysed			Not analysed		Not analysed			Not analysed	Yes	Yes
									S.E. = 1·86		S.E. = 1·94
									C.D. = 5·59		C.D. = 5.83


TILLERS, STRAW AND GRAIN. [G/POT]
No Silicate
Na Silicate
Ca Mg Silicate
Grams Per Pot
Tiller Counts (Numbers)
days
Straw
Grain
N0
N1
N2
4,7
17
2,8
2,8
2,8
8,5
4,7
12,7
6,8
3,6
2,9

Results and Discussion: The increased tiller count (Table) observed at the final count proved that calcium magnesium silicate treatment to be the best (T_6). This is in conformity with the observations of Tahahashi (1961) and Mitsui and Tahahashi (1963). The improved tillering capacity observed may be due to beneficial soil condition brought about by calcium and magnesium ingredients present in the carrier. Calcium magnesium silicate treated plants proved to have better root development. This has been established previously by Gaussman (1962). The statistical analysis of straw yield showed that silicate individually or in combination, proved better than no silicate treatments in increasing the yield of straw. Calcium magnesium silicate or sodium silicate at 60 and 90 lb N level gave significantly high yield. The superiority of treatments with silicon over no silicate treatments in all the three stages were in accordance with the findings of Ishibashi and Hayakawa (1939). The analysis of variance of grain yield showed that T_8 and T_9 both individually or in combination have significant effect in increasing the grain output. The above observations thus lend further supporting evidence for the beneficial effect of silicon in rice nutrition recorded by Wolff and Kreuzhage (1889) and Padmaja and Verghese (1964).

Summary and Conclusion: A pot culture experiment was laid out with nine treatments to study the influence of silicon on growth and yield of rice. Periodical observations on growth and tillers as well as yield of roots, straw and grain were made. The influence of silicon when applied at the rate of 100 lb SiO_2 per acre in increasing the tillering capacity, better root development, higher straw and grain yield are discussed in the light of earlier findings. Sodium silicate treatments proved better at the initial stage in increasing the number of tillers, but calcium magnesium silicate treatment took the lead at the later stages especially at 60 lb nitrogen level. The influence of silicon on straw and grain yield was better pronounced at higher levels of nitrogen. Thus the present investigation revealed that silicon nutrition of rice at the rate of 100 lb SiO_2 per acre brings about various beneficial effects.

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