J Krishi Vigyan 2018, 6(2) : 75-77 DOI : 10.5958/2349-4433.2018.00064.8

Effect of Silicon on Soil Physico-chemical Properties in Laterite derived Paddy Soils of Kerala

Guntamukkala Babu Rao[1], Poornima Yadav P I[2] and Elizabeth K Syriac[3]

Krishi Vigyan Kendra, Kottarakkara, Kollam (Kerala)

ABSTRACT

A field experiment was conducted during kharif, 2016 at the farmer's field in Kerala, to evaluate the effect of various sources of silicon on soil pH, OC, EC and soil texture. Experiment was laid out in randomised block design replicated thrice with seven treatments using Uma as the test variety. The treatments comprised of silicon sources viz., fine silica, rock dust, rice husk ash and potassium silicate, along with the recommended dose of fertilizers as per Kerala Agricultural University. Among the treatments, recommended dose of NPK kg/ha+fine silica@50 kg/ha+ rice husk ash@ 250 kg/ha, had shown better results with respect to soil pH and OC.

Key Words: Aluminium, iron, Laterite soils, Organic carbon, Rice, Silicon, Soil acidity, Texture.

INTRODUCTION

Rice is the most vital staple food of Kerala. For the past few years, there was a drastic decrease in area and production of rice due to soil associated constraints (Maneesh and Deepa, 2016). About 65 per cent of Kerala soils are lateritic in nature which requiresdistinct management package as these soils are low to medium in OC, N and K, very low in Ca and Mg. In addition to low fertile soils, high acidity, iron and aluminium toxicities are important soil linked constraints, resulting poor crop productivity in iron toxic laterite soils, especially in lowland situation (GOK, 2016).

Silicon (Si) nutrition in rice helps in enhancement of growth and yield, imparts resistance against lodging, abiotic and biotic stress (Epstein, 2001). Silicon is known to reduce the concentration of toxic elements like Fe, Al, other heavy metals in laterite derived paddy soils and also improve soil physical properties viz. pH, OC, EC and soil texture(Devanur, 2015). Therefore, a continued supply of Silicon would be required for the healthy and productive development of plant during all growth stages(Savant *et al,* 1997; Rao *et al,* 2017). With this background the present investigation was undertaken with an objective to assess the affect of silicon nutrition in rice on soil physic-chemical properties of laterite soils of Kerala.

MATERIALS AND METHODS

The field study was carried out at farmer's field in Kerala, during Kharif 2016. The soil of the experimental site was sandy clay loam, acidic in nature (pH 4.5), high in OC (1.01%) and EC (0.1 dS/m). Several silicon sources *viz*., fine silica, rock dust, rice husk ash and potassium silicate were used along with recommended fertilizers. All treatments were supplied with similar recommended dose of fertilizers i.e. lime@ 150kg/ha+farm yard manure@ 5t/ha+ NPK@ 90:45:120 kg/ha. The treatments were T1: Fine silica@ 100kg/ha; T2: Fine silica@ 75kg/ha+ rock dust@ 25kg/ha; T3: Fine silica@ 75 kg/ha+ foliar application of K_2SiO_3 at maximum tillering stage@ 0.5%; T4: Fine silica@ 50 kg/ha+ rock dust@ 25kg/ha+ foliar application of K_2SiO_3 at maximum tillering stage@ 0.5%; T5: Fine silica@ 75 kg/ha+ rice husk ash@ 125kg/ha;T6: Fine silica@ 50kg/ha+ rice husk ash@ 250kg/ha; T7: Fine silica@ 50kg/ha+ rice husk ash@ 125kg/ha+ foliar application of potassium silicate at maximum

Corresponding Author's Email: sekhar2486@gmail.com

[1]M.Sc. Scholar, Department of Agronomy, College of Agriculture, Vellayani, Kerala

[2]Assistant Professor, Krishi Vigyan Kendra, Kottarakkara, Kollam, Kerala

[3]Professor, Kerala Agricultural University, Thiruvananthapuram, Kerala

tillering stage@ 0.5%.

The experiment was laid out in randomized block design with seven treatments and three replications with each plot size of 5mx4m using rice variety Uma, which was transplanted during first week of July with a spacing of 20cmx15cm. Silicon sources such as fine silica, rock dust, rice husk ash were applied basally as per treatments at transplanting. Soil samples were analysed for pH at every fortnight until harvest. The initial soil and soil collected after the harvest were analysed for soil OC, EC and soil texture. The data obtained were subjected to statistical analysis.

RESULTS AND DISCUSSION

The data on the soil reaction (pH) are presented in Table 1. Soil pH after the harvest of the crop increased compared to the initial status (4.50). However the soil pH at fortnightly intervals was not influenced significantly, except at 3rd fortnight and at harvest. At 3rd fortnight, the highest soil pH of 5.84 was recorded by T6 and was significantly superior to all other treatments. The lowest soil pH value of 5.35 observed in T2 was at par with T7 and T1. After the harvest, the highest soil pH recorded in T7 (5.71) was at par with T6 (5.68), T1 (5.67), T5 (5.66) and T3 (5.66). The lowest soil reaction value of 5.59 observed in T2 was at par with T4.Soil reaction increased in all the treatments after the harvest compared to the initial value (4.50). This increase in soil reaction could be attributed to the fact that silicate materials can increase soil reaction and also help in correcting soil acidity by neutralizing exchangeable Fe, Al and Mn and other toxic elements (Sandhya, 2013). These results were also in line with that reported by Wallace (1993) and Qiang *et al* (2012).

The soil OC was found to vary significantly by silicon nutrition. The highest soil OC of 1.39 was recorded in the treatment T6 and was at par with T5 and T7 and significantly higher than all other treatments. The lowest value of 1.14 observed in T4 was at par with T1, T2 and T3. Treatments with rice husk ash (T5, T6, T7) resulted in significant increase in organic carbon content in soil compared to the other treatments. The increase in soil organic carbon was due to the reason that organic materials like rice husk ash had direct impact on mineralization rate and increases soil carbon directly. This was in agreement with the findings of Njoku *et al*(2011), who observed highest organic carbon content in the unburnt rice husk amended plots compared to the burnt rice husk ash.

The silicon application in soil resulted in non-significant effect on EC, but there has been a slight increase in soil EC after the experiment. This might be attributed to submergence, increase in solubility of salts present in the soil and also due

Table 1. Effect of silicon nutrition on soil reaction (pH) at fortnightly intervals.

Treatment	Soil reaction (pH)							
	1st FT	2nd FT	3rd FT	4th FT	5th FT	6th FT	7th FT	Harvest
T1	6.58	6.50	5.55	5.70	5.43	5.41	5.47	5.67
T2	6.58	6.44	5.35	5.53	5.35	5.31	5.30	5.59
T3	6.63	6.25	5.63	5.66	5.39	5.39	5.56	5.66
T4	6.55	6.55	5.62	5.62	5.36	5.34	5.74	5.62
T5	6.55	6.39	5.57	5.65	5.32	5.37	5.49	5.66
T6	6.53	6.42	5.84	5.85	5.30	5.37	5.68	5.68
T7	6.60	6.57	5.45	5.80	5.41	5.34	5.78	5.71
S E m±	0.044	0.150	0.089	0.109	0.044	0.063	0.141	0.025
CD (0.05)	NS	NS	0.195	NS	NS	NS	NS	0.066

FT = Fortnight

Table 2. Effect of silicon nutrition on Organic Carbon, Electrical conductivity mechanical composition of soil.

Treatment	Organic Carbon (%)	Electrical Conductivity (dS m-1)	Sand (%)	Silt (%)	Clay (%)	Soil texture
T1	1.18	0.14	51.50	5.70	43.20	Sandy clay loam
T2	1.18	0.14	53.93	5.16	41.13	"
T3	1.17	0.16	52.83	5.33	41.83	"
T4	1.14	0.13	52.33	5.33	42.33	"
T5	1.32	0.16	52.96	5.36	41.66	"
T6	1.39	0.14	53.83	5.06	41.10	"
T7	1.31	0.14	52.70	5.63	41.66	"
S E m±	0.051	0.000	0.876	0.346	0.687	-
CD (0.05)	0.113	NS	NS	NS	NS	NS

to the dissolution of silicon fertilizers. The data on mechanical composition of soil revealed that there were no significant variation among treatments regarding mechanical composition of the soil, after the experiment (Table 2). Initial soil texture and soil texture after the experiment are same i.e. Sandy clam loam. Silicon in soil increases soil reaction, slightly increases electrical conductance, improves physic-chemical soil properties and maintains nutrients in plant available form but will not change soil texture. Similar results have been reported by Berthelsen *et al* (2003).

CONCLUSION

The toxic build-up of Fe, Al, and high acidity together with silicon depletion were more common in tropical soils of Keralaleading to poor productivity of rice. The results of this experiment highlightedthat, application of fine silica @ 50 kg/ha+ rice husk ash@ 250 kg/ha was found to be effective for correcting soil pH and improving soil OC in iron toxic laterite soils, along with the present KAU recommended practices of lime@ 150 kg/ha+ farm yard manure @ 5t/ha+ NPK@ 90:45:120 kg/ha.

REFERENCES

Berthelsen S, Noble A D, Kingston G, Hurney A, Rudd A and Garside A(2003). Final Report, Sugar Research and Development Corporation Project CLW009.138p. [Online]. Available: http://elibrary.sugarresearch.com

Devanur V (2015). SILICON-Solution for tomorrow, Concept note. Available: http://www.privilife sciences.com/download/silicon-supplement.pdf

Epstein E (2001). Silicon in plants. *Stud Plant Sci* **8**: 1-15.

GOK [Government of Kerala](2016). Soils of Kerala [Online]. Available: http://www. keralaagriculture.gov.in

Rao G B, Poornima Yadav PI and Elizabeth K Syriac. (2017). Silicon nutrition in rice: A review. *J. Pharmacognosy Phtochemistry*. **6**(6): 390-392

Maneesh P and Deepa N R(2016). Trend Analysis of Area, Production and Productivity of Rice in Kerala in the Context of Food Security. *Int J Agric Res Rev* **4**(8): 538-546.

Njoku C, Mbah C N and Okonkwo C I (2011). Effect of rice mill wastes application on selected soil physical properties and maize yield on an ultisol in Abakaliki, southeastern Nigeria. *J Soil Sci Environ Manage* **2**(11):375–383.

Qiang F U, Hong H, Ming W U and Zheng C U(2012). Silicon-mediated amelioration of Fe2+ toxicity in rice (Oryza sativa L.) roots. *Pedosphere* **22**(6): 795-802.

Savant N K, Snyder G H and Datnoff L E (1997). Silicon management and sustainable rice production. *Adv Agron* **58**: 1245–1252.

Sandhya K (2013). Diatomaceous earth as a source of Silicon on growth and yield of Rice (Oryza sativa .L)M.Sc. (Ag) thesis, University of Agricultural Sciences, Bengaluru, 164p.

Wallace A (1993). Participation of silicon in cation-anion balance as a possible mechanism for aluminum and iron tolerance in some gramineae. *J Plant Nutr* **16**: 547-553.

Received on 11/10/17 *Accepted on 15/12/17*