INFLUENCE OF SILICON ON NUTRIENT UPTAKE AND SILICON USE EFFICIENCY OF AEROBIC RICE

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Abstract

Field experiment was conducted during Kuruvai, 2013 to study the influence of silicon on nutrient uptake and silicon use efficiency of aerobic rice. The treatments consisted of four rice varieties (ADT 47, ASD 16, CO 47 and IR 64) and four levels of silicon (0,120, 240 and 360 kg Si ha-^{1} through Diatomaceous Earth). The experiment was laid out in randomized block design with factorial arrangements and replicated thrice. Among the different rice varieties tried, ASD 16 recorded higher NPK and Si uptake and also recorded higher agronomic efficiency and apparent Si recovery. Regarding different levels of silicon, application of silicon at 360 kg ha^{-1} significantly increased the NPK and Si uptake of rice, however the maximum agronomic efficiency and apparent Si recovery was observed under 120 kg Si ha^{-1}. Among the different treatment combination of rice varieties and silicon levels, the maximum NPK and Si uptake was noticed with ASD 16 fertilized with silicon at 360 kg ha^{-1} and higher SiUE was noticed under ASD 16 with 120 kg Si ha^{-1} . Hence the results of the study showed that though the higher levels of silicon enhanced the nutrient uptake of rice under aerobic condition, the silicon use efficiency was higher at the lower levels.

Key words: silicon, aerobic rice, nutrient uptake, SiUE

INTRODUCTION

Aerobic rice is a production system where rice is grown in well-drained and non-saturated soils. Water requirement of rice can be lowered by reducing water losses due to seepage, percolation and evaporation. This method of cultivation involves direct sowing with surface irrigations when needed and is characterized by aerated soil environment during the entire growth period of crop comparable to other crops like maize and finger millet. Suitable varieties under aerobic cultivation save about 50-60 per cent of irrigation water. It is also reduces the emission of methane and contributes to lowering of greenhouse gas emission (Anonymous, 2008). To make aerobic rice successful, new varieties and management practices should be developed. Since this is a new concept, there is need to screen more fertilizer responsive and high yielding cultivars adapted to aerobic condition.

Silicon (Si) is the second most abundant element of the earth's surface. It plays an important role in imparting biotic, abiotic stress resistance and enhancing crop productivity. Silicon is the only element known that does not damage the crop plants with excess accumulation. Recently Si has been reported as quasi-essential element which enhances pest and disease resistance in plants and mitigates metal toxicities (Epstein, 2002). It also offer resistant to drought and minimize lodging in the cereal crops. Soil application of silicon enhances the uptake of other nutrients by rice crop, soil nutrient availability and silicon use efficiency (Jawahar, 2011). Diatomaceous earth or DE is a naturally occurring, soft, siliceous sedimentary rock contains 80–90 % silica, 2–4 % alumina and 0.5–2 % iron oxide. Now a day it is used as a source of silicon nutrition for crop production. The available literature on the effect of DE on rice crop is limited particularly under aerobic condition. Therefore, the present investigation was carried out to study the influence of silicon on nutrient uptake and silicon use efficiency of aerobic rice.

MATERIALS AND METHODS

An experiment was conducted during Kuruvai, 2013 to study the influence of silicon on nutrient uptake and silicon use efficiency of aerobic rice. The field experiment consisted of four rice varieties (V1-ADT 47, V2-ASD 16, V3-CO 47 and V4- IR 64) and four levels of silicon (Si_1 - 0, Si_2 -120, Si_3 - 240 and

Si_4 - 360 kg Si ha^{-1} through Diatomaceous Earth). The experiment was laid out in randomized block design with factorial arrangements and replicated thrice. The rice crop was fertilized with 120:38:38 kg of N, P_2O_5 and K_2O ha^{-1} The entire dose of P_2O_5 and K_2O and half of the dose 'N' was applied as basal along with different level of silicon through Diatomaceous earth. The remaining half of N was top dressed in two equal splits each at active tillering and panicle primordial initiation stages. The NPKSi uptake was recorded at harvesting stage. The silicon use efficiency was calculated using the formula as suggested by Pillai and Vamadevan (1978).

RESULTS AND DISCUSSION

The nutrient uptake and silicon use efficiency was significantly influenced with rice varieties and silicon application under aerobic condition.

Nutrient uptake

Rice varieties significantly influenced the NPK and Si uptake and the maximum uptake was recorded at ASD 16 (Fig 1). The increased NPK and Si uptake by rice crop could be due to enhanced root system and adaptation ASD 16 under aerobic condition. Further application of silicon increased the availability of other nutrients results in higher nutrient uptake of rice.This is accordance with the finding of Yogendra (2014). The lowest nutrient uptake was recorded under IR 64 due to poor root activities and decreased biomass. Application of Si at 360 kg ha^{-1} (Si_4) significantly increased NPK and Si uptake of rice under aerobic condition. This finding is in agreement with the reports of Jawahar (2011). Combined effect of rice varieties and silicon recorded higher NPK and Si uptake of rice over their individual effect. The maximum NPK and Si uptake was noticed with ASD 16 and silicon at 360 kg ha^{-1} (V_2Si_4).

Silicon use efficiency (SiUE)

Rice varieties significantly influenced the SiUE *viz*., agronomic efficiency and apparent Si recovery of rice (Fig 2). The highest value on SiUE was noticed with ASD 16 (V_2). This could be due to increased root growth and effective utilization of applied silicon. Among the levels of silicon, the higher SiUE *viz*., agronomic efficiency and apparent Si recovery was observed under 120 kg Si ha^{-1} (Si_2). Increasing silicon levels to rice drastically reduced the agronomic efficiency and the maximum agronomic efficiency was associated with lowest levels of 120 kg Si ha^{-1} due to effective utilization of applied Si, while the lowest value was linked with highest level of 360 kg Si ha^{-1}. Regarding interaction, the maximum SiUE was noticed with ASD 16 and 120 kg Si ha^{-1} (V_2Si_4). Therefore the results of the present study revealed that application of silicon at higher levels enhanced the nutrient uptake of aerobic rice by increasing soil available nutrients and silicon at lower levels favoured for higher silicon use efficiency.

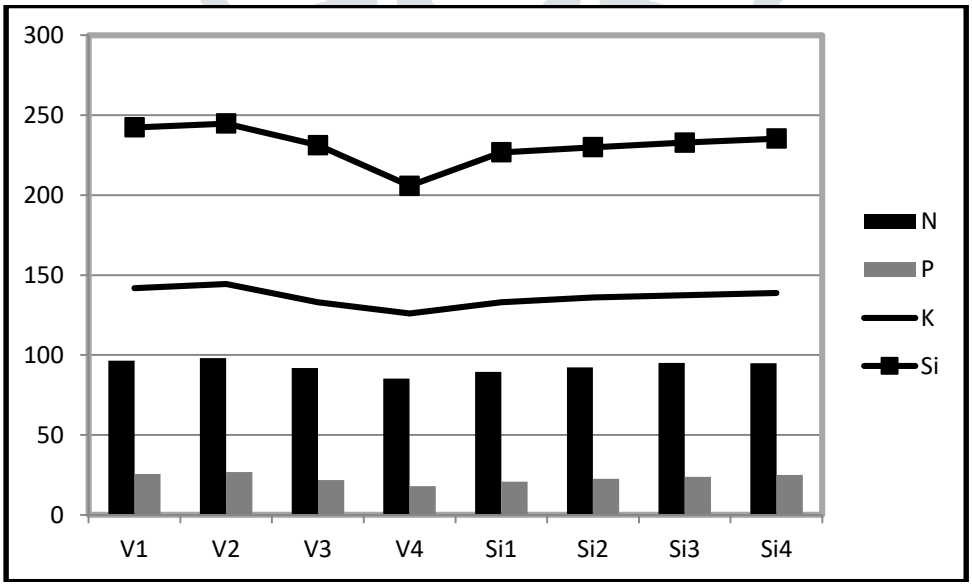

Fig 1. Influence of silicon through diatomaceous earth on nutrient uptake (NPKSi) (kg ha^{-1}) of aerobic rice

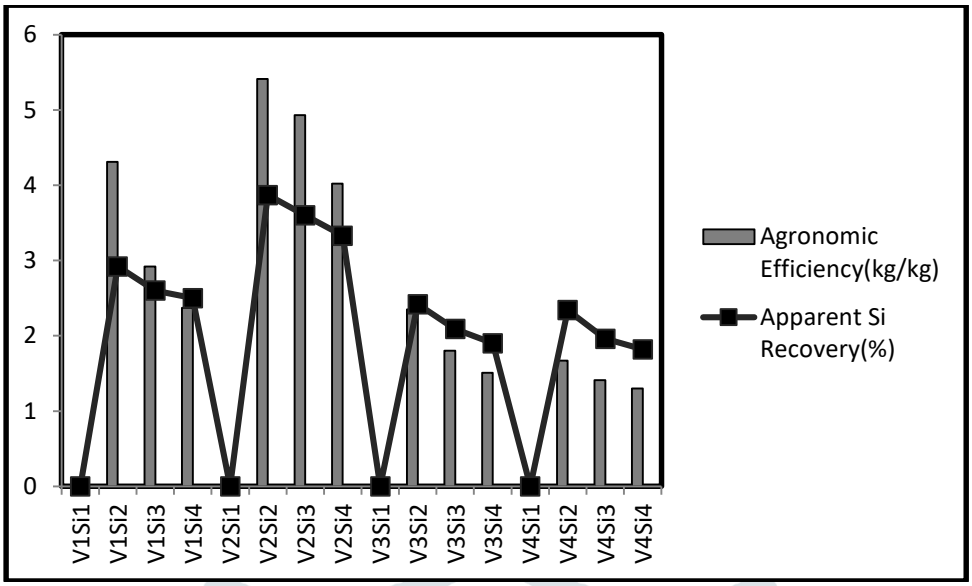

Fig 2. Influence of silicon through diatomaceous earth on agronomic efficiency (kg kg^{-1}) and apparent Si recover (%) of aerobic rice

References

Anonymous, 2008. Package of practice of field crops. Univ. Agic. Sci., GKVK. Banglore. 67-71.

Epstein E.2002.Silicon in plants: Facts VS. Concepts: Silicon in Agriculture. Elsevier. 1-15.

Jawahar.S. 2011. Studies on the effect of sulphur and silicon fertilization in rice-pulse cropping system for cauvery delta zone. Ph.D, Thesis submitted to Annamalai University, Annamalai Nagar, India.

Munir M., Carles ,ACC, Heilo, GF. and Juliano CC.2003. Nitrogen and silicon fertilization of upland rice. Science Agricola. 4: 1-10.

Pillai, K.G. and V.K. Vamadevan. 1978. Studies on integrated nutrient supply system for rice. Fert. News, 23(3): 11-14.

Subramanian,S.and A. Gopalswamy.1990. Effect of moisture, organic matter, phosphate and silicate on availability of silicon and phosphorus in rice soils.J.IndianSoc.Soil Sci.,39(1):99-103.

Xiong, Z., Liu, Y., Wu, Z., Zhang, X., Liu, P., Huang, T. 2015. Differences in net global warming potential and greenhouse gas intensity between major rice-based cropping systems in China. *Scientific Reports* 5, 1-9.

Yogendra, N.D, B.H.Kumara, N, Chandrashekar, N.B.Prakasn, M.S.Anatha and H.M.Jeyedeva. 2014. Effect of s14'con on real time nitrogen management in am'v ecosystem. 47r.J.Agric Res. Vol. 9(9), pp.831-840.

Yogendra.N.D.2010.Effect of silicon on site specific nitrogen management by adopting LCC in rice ecosystem.M.Sc.(Ag.) Thesis, UAS, Bangalore, India.