Full Length Research Article

© 2024, Centre for Advanced Research in Agricultural Sciences
Research Journal of Agricultural Sciences
Volume 15; Issue 04 (Jul–Aug 2024); pp 1023–1025

ISSN: 0976-1675 (P)
ISSN: 2249-4538 (E)

Effect of Silicon through Root Treatment and Foliar Spray on Yield of Rice in Medium Black Soils of Konkan

A. A. Dademal*[1], M. C. Kasture[2], N. V. Mhaskar[3], S. S. More[4] and C. S. Kadam [5]

[1-5] Agricultural Research Station, Repoli, District Raigad, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri - 415 712, Maharashtra, India

Received: 17 May 2024; Revised accepted: 02 Aug 2024

Abstract

A field experiment was conducted at Agricultural Research Station, Repoli District Raigad (Maharashtra) during the *Kharif* season of 2022 to study the effect of silicon on growth and yield of rice under medium black soils of Konkan. The number of panicles hill^{-1} (15.75) and length of panicle (22.25 cm) was recorded highest in treatment where silicon was applied through root treatment and three sprays @ 4 ml / lit. Similarly, the significantly higher grain (53.36 q ha^{-1}) and straw yield (69.37 q ha^{-1}) was recorded in treatment T_3 (Silicon - Root Sapling and 3 Spray @ 4 ml / lit) over rest of the treatments.

***Key words*:** *Oryza sativa*, Foliar spray, Silicon, Growth, Yield

Rice (*Oryza sativa*) is an important food crop extensively grown in Konkan. Rice cultivation needs urgent emphasis regarding it restore in productivity. It is essential to increase rice productivity under the scenarios of increasing food demand in response to consistent population growth as well as agricultural land shrinkage. India is the largest producer of rice cultivation is 44 million hectares with production of 102.32million tones and average productivity of 2550 kg ha^{-1} [1]. In Maharashtra area under rice is 1.53million hectares with production of 3.51 million tones and average productivity of 1873 kg ha^{-1}. Rice plant has been considered to be a typical siliciphilous plant. It is recognized that silicon promotes photosynthesis, prevent fungal and insect injuries and alleviates lodging [2]. Due to these benefits, silicon is often added to rice fields, either through soil amendments like silicon fertilizers or by using silicon-rich organic materials. Seok and Ota [3] was reported that the content of silicon in the hull was always higher in fertile than sterile panicles and that the higher silicon content in fertile panicles was related to the transpiration of the panicles they suggested that silicon play an important role in the ripening of the panicles. Rice is a high silicon accumulating plant which contains Si at levels up to 10% in dry matter [4]. It is estimated that to produce a total grain yield of 5.0 t ha^{-1}, rice crop removes 230-470 kg Si ha^{-1} from soil [5]. Intensive agriculture which brings high productivity together with high removal of silicon be the reason of reduction of silicon level in soil [6]. As the Si is continuously removed through harvested crop and soil nutrients were not replenished by fertilizer application, the Si may possibly decrease from season to season. Foliar fertilization is the application of nutrients, plant hormones, bio-stimulants and other beneficial substances to the leaves and stem of the plants. The application of these substances during growth and development can improve the nutrient balance of crop, which turn into increase yield and quality of crop. In cognizance of the above facts, the present investigation was carried out.

MATERIALS AND METHODS

Field experiment was conducted during *Kharif* season of 2022-23 at Agricultural Research Station, Repoli, District Raigad (Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli) (25°16′4.3608″ N latitude, 82°59′25.7784″ E longitude and altitude of 80.71 m above mean sea level) in Maharashtra of India. The initial analysis of experimental soil revealed that the soil was Medium black soil with pH 6.7, organic carbon 9.60 g kg^{-1}, available Nitrogen 232.07 kg ha^{-1}, available Phosphorus 19.89 kg ha^{-1}and available Potassium 254.14 kg ha^{-1}. The experiment was laid out in randomized block design (RBD) which consist six treatments with four replications. The treatments are as given below:

Treatment No.	Treatment details	Dose
T_1	Silicon (Root Sapling and 3 Spray)	1 ml / lit
T_2	Silicon (Root Sapling and 3 Spray)	2 ml / lit
T_3	Silicon (Root Sapling and 3 Spray)	4 ml / lit
T_4	Silicon (Root Sapling and 3 Spray)	4 ml / lit and 2 ml /lit spray
T_5	Silicon (Root Sapling and 2 Spray)	2 ml / lit
T_6	Control (Untreated)	Water spray

Nursery was sown in a row having spacing of 10 cm apart at a seed rate of 50 kg ha^{-1} on 24th June 2022for

***Correspondence to:** A. A. Dademal, E-mail: adademal@gmail.com; Tel: +91 9423909575

Citation: Dademal AA, Kasture MC, Mhaskar NV, More SS, Kadam CS. 2024. Effect of silicon through root treatment and foliar spray on yield of rice in medium black soils of Konkan. *Res. Jr. Agril. Sci.* 15(4): 1023-1025.

experimental plot having size 4.5 m × 4.0 m and 25-30 days old seedling were used for transplanting of rice crop on 20th July 2022 which was harvested on 28th October 2022. The crop was uniformly fertilized with 100 kg N, 50 kg P_2O_5 and 50 kg K_2O per hectare giving half of the nitrogen and full dose of phosphorus and potassium as basal dose. Remaining nitrogen was top dressed in two equal splits at 25 and 60 days after transplanting was applied to all the treatment except control. The other recommended cultural practices and plant protection measures were followed for the healthy crop. Weeding was done manually 20 and 40 DAT. The silicon was applied as per treatment through Root sapling (dipping of roots of rice seedling) and spray @ 1, 2 and 4 ml in 1 liter of water and foliar spray at maximum tillering, flowering and at grain filling stage as per the treatment. The growth and yield observations from each plot were recorded at harvest. The data collected on growth and yield of crop were statistically analyzed as per the standard analysis of variance (ANOVA) procedure for randomized block design and the Critical Difference (CD) test at 5% probability was calculated to detect the difference between treatment means.

RESULTS AND DISCUSSION

Effect of silicon on growth parameters

Plant height (cm)

The perusal of the data furnished in the (Table 1) showed significant effect on different levels of silicon on plant height of rice at all stages of crop growth during *kharif* season. The maximum plant height was recorded in treatment T_3 (Si applied through root sapling and 3 spray @ 4 ml lit^{-1}) at all the stages of growth [7]. All the treatments were significantly superior to control treatment (T_6).

No. of tillers $hill^{-1}$

The data pertaining to the number of tillers $hill^{-1}$at 30 and 60 DAT are presented in (Table 1). It observed that the number of tillers increased from 30 DAT to a maximum at60 DAT. The significantly highest number of tillers $hill^{-1}$at 30 and 60 DAT were recorded in the treatment T_3 which receives silicon through root sapling and 3 spray @ 4 ml $lit^{-1}$and the lowest numbers of tillers were recorded in treatment T_6 (control) [8].

Table 1 Effect of Silicon on growth characters of rice

Treatment	Plant height (cm)			Number of tillers $hill^{-1}$	
	30 DAT	60 DAT	At harvest	30 DAT	60 DAT
T_1: Silicon (Root Sapling and 3 Spray) @ 1 ml /lit	39.00	78.25	85.25	11.00	15.50
T_2: Silicon (Root Sapling and 3 Spray) @ 2 ml /lit	43.75	89.50	100.00	14.75	18.50
T_3: Silicon (Root Sapling and 3 Spray) @ 4 ml /lit	46.75	97.00	109.25	17.50	21.00
T_4: Silicon (Root Sapling and 3 Spray) @ 4 ml /lit and 2 ml/lit spray	46.00	90.50	101.75	14.50	16.25
T_5: Silicon (Root Sapling and 2 Spray) @ 2 ml /lit	44.25	87.75	98.50	13.00	15.50
T_6: Control (Untreated)	27.75	69.50	81.25	9.00	11.50
S.E±	0.70	1.17	1.83	0.65	0.47
CD at 5%	2.11	3.55	5.52	1.96	1.42

Effect of silicon on yield attributing characters and yield of rice

It was observed from data presented in (Table 2). The number of panicles $hill^{-1}$ and length of panicle and Test weight was significantly influenced by different doses of silicon [9].

Number of panicles $hill^{-1}$

The data on the number of panicles $hill^{-1}$ was presented in (Table 2) indicated that the number of panicles $hill^{-1}$ significantly increased due to various treatments. The significantly highest number of panicles $hill^{-1}$ was recorded in the treatment T_3 where Si applied through root sapling and 3 spray @ 4 ml / lit was applied and minimum numbers of panicles $hill^{-1}$ were recorded in control treatments (T_6). Silicon application, especially through root sapling and foliar sprays, effectively enhances important yield-contributing characters in rice, such as the number of panicles per hill [10].

Length of panicles (cm)

The values on the length of panicle was presented in (Table 2) which found that the maximum length of panicle (22.25cm) was observed in the treatment T_3 (Si applied through Root Sapling and 3 Spray @ 4 ml / lit) and the lowest length of panicle was recorded in absolute control [11]. This data demonstrates that silicon application significantly improves the panicle length in rice, with Treatment T3 showing the most substantial effect.

Test weight (g)

The data about 1000 grain weight is presented in (Table 2). The significantly higher value of 1000 grain weight was recorded in treatment T_3 (Si - root sapling and 3 spray @ 4 ml / lit) over rest of the treatments except T_2 and T_4. The lowest value of test weight was observed in the control treatment [12].

Table 2 Effect of Silicon on yield attributing characters and yield of rice

Treatment	Number of panicles $hill^{-1}$	Length of panicle (cm)	Test weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
T_1: Silicon (Root sapling and 3 spray) @ 1 ml / lit	12.00	18.75	21.08	42.92	55.80
T_2: Silicon (Root sapling and 3 spray) @ 2 ml / lit	13.50	21.00	22.98	46.91	60.99
T_3: Silicon (Root sapling and 3 spray) @ 4 ml / lit	15.75	22.25	23.98	53.36	69.37
T_4: Silicon (Root sapling and 3 spray) @ 4 ml / lit and 2 ml/lit spray	12.50	21.00	22.68	47.14	61.28
T_5: Silicon (Root sapling and 2 spray) @ 2 ml / lit	12.00	20.00	21.38	44.91	58.39
T_6: Control (Untreated)	7.50	17.75	19.70	19.49	25.34
S.E±	0.48	0.49	0.45	0.57	0.74
CD at 5%	1.45	1.50	1.36	1.73	2.24

Grain and straw yield (q ha^{-1})

Data pertaining to the grain yield (q ha^{-1}) and straw yield (q ha^{-1}) are presented in (Table 2). The results indicated that the effects of levels of silicon were found significant on grain and straw yield of rice. The significantly higher grain (53.36 q ha^{-1}) and straw yield (69.37 q ha^{-1}) was recorded in treatment T_3 (Si - root sapling and 3 spray @ 4 ml / lit) over rest of the treatments [13-15]. The lowest value of grain and straw yield was recorded in control treatment (T_6). This data confirms the positive effects of silicon on rice yield, with significant improvements in both grain and straw yields when silicon was applied through root sapling and multiple sprays compared to the control treatment with no silicon application [16].

CONCLUSION

From the field experiment conducted for effect of silicon applied through root sapling and foliar spray on rice during *Kharif* season, it could be concluded that application of silicon through root sapling and foliar application (3 sprays) at maximum tillering, flowering and grain filling stage @ 4ml lit^{-1} along with recommended dose fertilizer (100:50:50kg NPK ha^{-1}) produced significantly higher growth, yield contributing characters and yield of rice. This combination produced significantly higher growth, yield-contributing characters. This suggests that integrating silicon application with standard fertilizer practices can substantially enhance rice production.

LITERATURE CITED

1. Karennavar SS, Chavan VG, More VG, Dhopavkar RV, Desai SS, Bodake PS. 2022. Effect of humic acid-based bio-stimulant on growth, yield and yield attributing characters of *kharif* rice .2022. *The Pharma Innovation Journal* 11(11): 319-322.
2. Jianfeng MA, Nishimura K, Takahashi E. 1989. Effect of silicon on growth of rice plant at different growth stages. *Soil Science and Plant Nutrition* 35(3): 347-356.
3. Seak WS, Ota Y. 1982. Role of hull in ripening of rice plant. Changes in content in mineral demand of hull during ripening. *Japan Journal of Crop Science* 51: 97-104.
4. Ma JF, Yamaji N. 2006. Silicon uptake and accumulation in higher plants. *Trends in Plant Science* 11: 392-393.
5. Radrigus FA, Datoff LE. 2005. Silicon and rice disease management. *Fitopatologia Brasilaria* 30: 457-469.
6. Swe MM, Mar SS, Naing TT, Zar T, Ngwe K. 2021. Effect of silicon application on growth, yield and uptake of rice in two different soils. *Open Access Library Journal* 8: 1-15.
7. Pati S, Pal B, Badole S, Hazra GC, Mandal B. 2016. Effect of silicon fertilization on growth, yield, and nutrient uptake of rice. *Communications in Soil Science and Plant Analysis* 47: 284-290. https://doi.org/10.1080/00103624.2015.1122797
8. Guntzer F, Keller C, Meunier JD. 2012. Benefits of plant silicon for crops: A review. *Agronomy for Sustainable Development* 32: 201-213. https://doi.org/10.1007/s13593-011-0039-8
9. Agostinho FB, Tubana BS, Martins MS, Datnoff LE. 2017. Effect of different silicon sources on yield and silicon uptake of rice grown under varying phosphorus rates. *Plants* 6: Article No. 35. https://doi.org/10.3390/plants6030035
10. Patil AA, Durgude AG, Pharande AL. 2018. Effect of silicon application along with chemical fertilizers on nutrient uptake and nutrient availability for rice plants. *International Journal of Communication Systems* 6: 260-266.
11. Cuong TX, Ullah H, Datta A, Hanh TC. 2017. Effects of silicon-based fertilizer on growth, yield and nutrient uptake of rice in tropical zone of Vietnam. *Rice Science* 24: 283-290. https://doi.org/10.1016/j.rsci.2017.06.002
12. Matichenkov VV, Bocharnikova EA, Calvert DV, Snyder GH. 2000. Comparison study of soil silicon status in sandy soils of South Florida. *In*: *Proceedings- Soil and Crop Science Society of Florida* 59: 132-137.
13. Pati S, Saha S, Hazra GC, Saha BN, Pal B, Mandal B. 2017. Distribution of silicon in rice growing soils of West Bengal in relation to some important soil chemical properties. *Journal of the Indian Society of Soil Science* 65: 181-188. https://doi.org/10.5958/0974-0228.2017.00021.4
14. Agostinho, Flavia B, Tubana BS, Martins MS, Datnoff LE. 2017. Effect of different silicon sources on yield and silicon uptake of rice grown under varying phosphorus rates. *Plants* 6(3): 35.
15. Crusciol CAC, Soratto RP, Castro GSA, Neto JF, Costa CHM. 2013. Leaf application of silicic acid to upland rice and corn. *Ciênc. Agrár*. 34: 2803-2808.
16. Meena VD, Dotaniya ML, Coumar V. 2014. A case for silicon fertilization to improve crop yields in tropical soils. *Proc. Natl. Acad. Sci., India, Sect. B Biol. Science* 84: 505-518.