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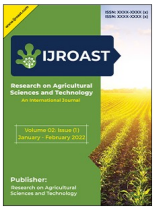

Effect of Silicon on yield and economics of transplanted paddy under wetland ecosystem

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ABSTRACT

Field experiment was conducted at farmer's field, Keezhamankudi village, Bhuvanagiri taluk of Cuddalore district to study the effect of silicon on yield and economics of transplanted paddy under wetland ecosystem from February to June, 2020. The experiment was laid out in Randomized Block Design (RBD) replicated thrice with thirteen treatments. Among the different treatments, application of 125 % RDF + Soil application of Silica GR (soil conditioner) @ 25 kg ha^{-1} + Soil application of Micronutrient mixture (TN grade XI) @ 12.5 kg ha^{-1} (T_{13}) significantly recorded higher number of panicles m^{-2} (642), number of grains $panicles^{-1}$ (138.98), grain yield (6854 kg ha^{-1}), straw yield (9842 kg ha^{-1}) and economics (BCR : 2.7). Hence, treatment T_{13} enhances the productivity of transplanted paddy through which it earns higher profitability for rice growing farming community.

Introduction

Rice (*Oryza sativa* L.) is the most important cereal crop among staple food crops which sustains about two thirds of the world's population. More than 90 % of the world rice is produced and consumed in Asia, which is a native for 60 % of the earth's population. India is the second largest producer of rice after China. Globally rice is grown on an acreage of 160.70 million hectares with total production of 497.71 million tonnes and productivity of 4.62 ton ha^{-1}. In India, rice is grown in an area of 43.66 million hectares having an annual production of 118.87 million tonnes with a productivity of 4.08 t ha^{-1} [1]. In Tamil Nadu, rice is cultivated in an area of 18.50 lakh hectares with a production of 72.00 lakh metric tonnes and productivity of 3.89 t ha^{-1} [2].

The world population has grown at an exponential rate that necessitates the need for adoption of the practices which helps in maintaining soil health, keeps the rice production sustainable and provides qualitative food for meeting the nutritional requirement of human beings. Adequate nutrient management is essential to enhance its productivity to satisfy the rising global food demand without adverse impact on environment [3]. Interestingly, the only non-essential nutrient that is included in the guidelines for rice fertilization is silicon (Si) [4]. Silicon (Si) is the second most abundant element after oxygen in the Earth's crust and plays a significant role in imparting biotic, abiotic stress resistance and enhancing crop productivity [5]. Plants can only absorb Si in the form of soluble mono silicic acid (H_2SiO_4) [6].

Rice is a high silicon accumulating plant and its absorption brings several benefits such as making leaves more erect, thus reducing self-shading which in turn boosting light interception, enhancing the root system, increasing cell wall thickness below the cuticle and improving plant defense mechanism, [7]. Hence, Si is a beneficial element for plant growth and is agronomically essential for improving and sustaining rice productivity. Although silicon is present in the soil in large amounts, it's availability to plants is limited and would benefit from silicon fertilization. Considering the above facts, the present investigation was carried out to study the effect of silicon on yield and economics of transplanted rice.

Materials and Methods

Field experiment was carried out at farmer's field, Keezhamankudi village, Bhuvanagiri taluk of Cuddalore district to study the effect of silicon on yield and economics of transplanted paddy under wetland ecosystem from February to June, 2020. The experimental field was located at 11° 43′ N latitude and 79° 49′ E

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longitude at an altitude of +5.79 m above mean sea level. The soil of the experiment site is clay loam in texture (Soil pH 8.4; EC 0.89 dSm^{-1}). The available soil nitrogen, phosphorus, potassium and silicon were 248, 17.18, 310 and 268 kg ha^{-1} respectively. The experiment was laid out in Randomized Block Design (RBD) replicated thrice with thirteen treatments *viz.,* T_1 - Without any fertilizer application (control), T_2 - RDF alone (120:40:40 kg of NPK ha^{-1}), T_3 - Soil application of Silica GR (soil conditioner) @ 25 kg ha^{-1}, T_4 - RDF + Soil application of Silica GR (soil conditioner) @ 25 kg ha^{-1}, T_5 - RDF + Soil application of Micronutrient mixture (TN grade XI) @ 12.5 kg ha^{-1}, T_6 - RDF + Soil application of Silica GR (soil conditioner) @ 25 kg ha^{-1} + Soil application of Micronutrient mixture (TN grade XI) @ 12.5 kg ha^{-1}, T_7 - 75 % RDF + Soil application of Silica GR (soil conditioner) @ 25 kg ha^{-1}, T_8 - 75 % RDF + Soil application of Micronutrient mixture (TN grade XI) @ 12.5 kg ha^{-1}, T_9 - 75 % RDF + Soil application of Silica GR (soil conditioner) @ 25 kg ha^{-1} + Soil application of Micronutrient mixture (TN grade XI) @ 12.5 kg ha^{-1}, T_{10} - 125 % RDF alone, T_{11} - 125 % RDF + Soil application of Silica GR (soil conditioner) @ 25 kg ha^{-1}, T_{12} - 125 % RDF + Soil application of Micronutrient mixture (TN grade XI) @ 12.5 kg ha^{-1}, T_{13} - 125 % RDF + Soil application of Silica GR (soil conditioner) @ 25 kg ha^{-1} + Soil application of Micronutrient mixture (TN grade XI) @ 12.5 kg ha^{-1}. Entire dose of P_2O_5 was applied as basal. N and K_2O were applied in four equal splits at basal, tillering, panicle initiation and heading stages. The rice variety chosen for study was ADT 43. Biometric observations were recorded at harvest and economics were worked out based on the inputs cost, labour charges and market value of the produces. The data's were statistically analyzed as suggested by [8].

Results and discussion

Yield attributes and Yield

Yield attributes and yield of rice was significantly increased with silicon fertilization (Talble 1). Among different treatments, application of 125 % RDF + Soil application of Silica GR (soil conditioner) @ 25 kg ha^{-1} + Soil application of Micronutrient mixture (TN grade XI) @ 12.5 kg ha^{-1} (T_{13}) recorded higher number of panicles m^{-2} (642), number of grains $panicles^{-1}$ (138.98), test weight (15.94 g), grain yield (6854 kg ha^{-1}) and straw yield (9842 kg ha^{-1}) in transplanted rice. Application of 125 % RDF + Soil application of Silica GR (soil conditioner) @ 25 kg ha^{-1} (T_{11}) was next in order which recorded number of panicles m^{-2} of 603, number of grains $panicles^{-1}$ of 135.12, test weight of 15.90 g, grain yield of 6349 kg ha^{-1} and straw yield of 9438 kg ha^{-1}. This was on par with 125 % RDF + Soil application of Micronutrient mixture (TN grade XI) @ 12.5 kg ha^{-1} (T_{12}). The least values for yield attributes were recorded under the control (T_1).

The increase in number of panicles m^{-2} could be due to the more number of productive tillers, which resulted in higher number of panicles per unit area. This was in harmony with the findings of [9]. Increased filled grain number was due to better assimilation of carbohydrate in panicle [10]. Si application increased the availability of essential nutrients in the soil and improved their uptake by rice which enhanced the growth attributes and improved the photosynthetic activity of the plant resulted in increased biomass production and cumulative effect of these parameters together with improved translocation of source to sink led to higher grain and straw yields. These results were in line with findings of [11] and [12].

Table 1. Effect of silicon on yield attributes and yield of transplanted rice

Treatment	Yield attributes			Yield	
	No. of panicles m^{-2}	No. of grains $panicle^{-1}$	Test weight	Grain yield	Straw yield
T_1	215	63.19	15.46	1902	4510
T_2	320	100.86	15.61	4380	7208
T_3	261	95.40	15.53	3426	6194
T_4	480	123.60	15.79	5562	8515
T_5	474	122.52	15.78	5459	8380
T_6	549	129.42	15.85	5943	8953
T_7	370	108.51	15.67	4782	7715
T_8	328	102.25	15.62	4465	7346
T_9	416	115.75	15.72	5072	8039
T_{10}	493	125.10	15.81	5627	8611
T_{11}	603	135.12	15.90	6349	9438
T_{12}	591	134.96	15.89	6231	9272
T_{13}	642	138.98	15.94	6854	9842
SEm±	4.72	1.16	NS	57.43	99.86
CD (P=0.05)	13.83	3.42	NS	168.26	292.59

Economics

Application of silicon influenced the economics of transplanted paddy (Table 2). Among the different treatments, application of 125 % RDF + Soil application of Silica GR (soil conditioner) @ 25 kg ha^{-1} + Soil application of Micronutrient mixture (TN grade XI) @ 12.5 kg ha^{-1} (T_{13}) recorded higher net return of Rs. 87932 ha^{-1} and BCR of 2.78. This was significantly followed by application of 125 % RDF + Soil application of Silica GR (soil conditioner) @ 25 kg ha^{-1} (T_{11}) which recorded a net return of Rs. 78932 ha^{-1} and BCR of 2.63. This was on par with 125 % RDF + Soil application of Micronutrient mixture (TN grade XI) @ 12.5 kg ha^{-1} (T_{12}). The least net return and BCR were recorded under the control (T_1). This could be due to higher grain and straw yield obtained with the silicon fertilization. The results were in harmony with the findings of [13] and [14].

Table 2. Effect of silicon on economics of transplanted rice

Treatments	Cost of Cultivation (₹. ha^{-1})	Gross income (₹)	Net income (₹)	BCR
T_1	40780	39518	-1262	0.97
T_2	45480	88461	42981	1.95
T_3	42571	69638	27067	1.64
T_4	47271	111823	64552	2.37
T_5	46375	109770	63395	2.37
T_6	48166	119366	71200	2.48
T_7	46097	96456	50359	2.09
T_8	45202	90176	44974	1.99
T_9	46993	102191	55198	2.17
T_{10}	46659	113127	66468	2.42
T_{11}	48450	127382	78932	2.63
T_{12}	47554	125059	77505	2.63
T_{13}	49345	137277	87932	2.78

Conclusion

From the present study, it can be concluded that application of 125 % RDF + Soil application of Silica GR (soil conditioner) @ 25 kg ha^{-1} + Soil application of Micronutrient mixture (TN grade XI) @ 12.5 kg ha^{-1} (T_{13}) increased the yield and economics of transplanted rice thereby it achieves the maximum productivity and profitability in rice production.

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