Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(1): 328-332
Received: 12-11-2017
Accepted: 14-12-2017

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Effect of nitrogen and silicon on growth and yield attributes of transplanted rice (*Oryza sativa L.)* under Kashmir conditions

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Abstract
The field experiment entitled “Effect of nitrogen and silicon on growth and yield attributes of transplanted rice (*Oryza Sativa L.*) Under Kashmir conditions was conducted at Agronomy Research Farm of Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir during Kharif season 2014 and 2015. The soil of the experiment was silty clay loam in texture, neutral in reaction with medium available nitrogen (442.88kg ha^{-1}), phosphorus (9.3kg ha^{-1}), potassium (221.60kg ha^{-1}) and low available silicon (280.23kg ha^{-1}). The experiment was laid out in Factorial Randomized Completely Block Design assigning combinations of three nitrogen levels (N_1: 120, N_2: 150, N_3: 180 kg/ha) and four silicon applications (Si_0: Control, Si_1: 5%, Si_2: 10% and Si_3:15%) with four replications. The results revealed plant height was significantly highest with 180kgN ha^{-1} from 30DAT upto at harvest. Among silicon applications, plant height was significantly highest with 15%Si compared to rest of treatments during both the years. However, leaf area index were significantly highest with 180kgN ha^{-1} from 30-45DAT but from 60DAT upto harvest, leaf area index were significantly highest with 120kgN ha^{-1}.With regard to the effect of silicon applications, leaf area index was significantly highest with 15%Si during both the years. The yield attributes viz. panicle length, spikelets $panicle^{-1}$ and grains $panicle^{-1}$ were significantly higher with 120kgN ha^{-1} while same yield attributes were significantly highest with 15%Si during both the years. Different nitrogen levels and silicon applications failed to influence the 1000-grain weight significantly.

Keywords: Growth, Nitrogen, Rice, Silicon, Yield attributes

Introduction
Rice (*Oryza sativa L.*) is a staple food for more than half of the worlds population. Globally it is grown on an acreage of 158 million hectares with total production of 700 million tonnes and productivity 4.43 ton per hectare (FAO, 2014) [3]. In Jammu and Kashmir rice is grown on an area of 261.66 hectares with a production of 5456 quintals and productivity of 20.95 quintals per hectares (DES, 2012-2013). Application of nitrogen fertilizer is an important practice for increasing rice yield. It is essential to the rice plant, with about 75 per cent of leaf nitrogen associated with chloroplasts, which are physiologically important in dry matter production (Dalling, 1995) [1]. Rice plants require nitrogen during the vegetative phase to promote tillering, which determines the potential number of panicles. (Mae, 1997) [13]. Nitrogen contributes to spikelet production during the early panicle formation stage and contributes to sink size by decreasing the number of generated spikelets and increasing full size during the late panicle formation stage. Rice is considered to be a silicon accumulator plant and tends to actively accumulate Si to tissue concentrations of 5% or higher. Recently Si has been regarded as quasi-essential element for the growth of higher plants (Epstein, 2002) [4]. Reduced amount of silicon in plant produces necrosis, disturbance in leaf photosynthetic efficiency, growth retardation and reduces grain yield in cereals especially rice (Shashidhar *et al.*, 2008) [19]. Keeping in view the above facts, the present study was designed with the objective to study the effect of nitrogen and silicon on growth and yield attributes of transplanted rice.

Materials and Methods
The field experiment was carried out at Research Farm of Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar during Kharif season, 2014 and 2015. The soil of the experiment was silty clay loam in texture, neutral in reaction with medium available nitrogen, phosphorus, potassium and low available silicon. The factorial experiment (two factors) based on randomised complete block design with four replications

was laid out. The factors included three N levels (N_1: 120, N_2: 150, N_3: 180 kg/ha) and four Si applications (Si_0: Control, Si_1: 5%, Si_2: 10% and Si_3:15%) and the treatment combinations were N_1Si_0, N_1Si_1, N_1Si_2, N_1Si_3, N_2Si_0, N_2Si_1, N_2Si_2, N_2Si_3, N_3Si_0, N_3Si_1, N_3Si_2 and N_3Si_3.The plant height was measured from ground level to the apex of last fully opened leaf during vegetative period and upto the tip of the panicle after flowering. It was averaged and expressed in centimetres. The leaf area index was recorded at 15 days interval after transplanting using canopy analyser Accupan L-80.

$$\text{Leaf area index } \frac{\text{Total leaf area}}{\text{Ground area}}$$

Panicle length of ten randomly selected panicles from each plot was measured from neck node to the tip of panicle and then averaged and expressed in cm. Number of spikelets and grains of 10 randomly selected panicles from each plot were counted and then averaged as spikelets panicle^{-1} and grains panicle^{-1}. Samples of grain collected separately at the time of threshing from each plot were dried properly. 1000-grains from each of these samples were taken and their weights were recorded and expressed in grams.

Result and Discussion

Plant height is the primary growth determining character. The plant height as affected by different treatments is presented in fig 1. At 15DAT, non-significant difference was recorded with respect to nitrogen levels viz.120kgN ha^{-1},150kgN ha^{-1} and 180kg N ha^{-1} during 2014 and 2015. But from 30DAT upto harvest, significantly taller plants were observed with 180kgN ha^{-1} followed by 150kgN ha^{-1}. This could be attributed to the fact that nitrogen induced maximum vegetative growth at higher doses. These findings are in conformity with the results obtained by Mallick (1992) [14] and Roy *et al.* (2004) [17]. Significantly lowest plant height was observed with 120kgN ha^{-1} during both the years. Silicon treatments couldn't affect the plant height upto 30DAT. Significantly highest plant height was recorded with 15%Si followed by 10%Si which remained statistically at par with 5%Si from 45DAT upto harvest. This may be attributed to the fact that silicon helps in increase the erectness of leaves thereby increasing photosynthetic capacity which results in higher plant height. Similar findings were reported by Fallah (2012) [6]. Significantly lowest plant height was observed with control from 45DAT upto at harvest during both the years.

Leaf area index is an important parameter which influences the growth and yield of a crop and is mainly responsible for photosynthetic activity of the plant. Data presented in fig. 2 indicated that leaf area index increased gradually from 15DAT upto 60DAT followed by a sharp decline upto harvest during both the consecutive years. Among nitrogen levels, non-significant difference was observed at 15DAT with respect to all nitrogen levels. At 30DAT to 45DAT, significantly highest leaf area index was recorded with 180kgN ha^{-1} followed by 150kgN ha^{-1}. This might be due to more vegetative growth in higher level of nitrogen and the increasing trend of leaf area index at higher nitrogen levels can be attributed to the positive effect of nitrogen on both leaf development and leaf area duration. Our findings are in conformity with Fageria (2007) [7] and Fageria and Baligar (2005) [8]. From 60DAT upto harvest, leaf area index was significantly highest with 120kgN ha^{-1} during both the years. It might be due to the more number of tillers. Lowest leaf area index was observed with 120kgN ha^{-1}.The data further revealed that among silicon applications, non-significant difference was observed at 15DAT and 30DAT during both years. At 45DAT upto harvest, 15%Si caused highly significant improvement in leaf area index followed by 10%Si which remained at par with 5%Si.This could be ascribed to the fact that silicon increased number of tillers which ultimately results in higher leaf area index. Dobermann and Fairhurst (1997) [3] also mentioned positive effect of silicon on rice plant growth. Yield attributes viz., panicle length, spikelets per panicle and grains per panicle were significantly affected by nitrogen and silicon treatments (Table 1). The treatment with 120kgN ha^{-1} created significant variation in these yield attributes, 120kgN ha^{-1} proved significantly superior than other two nitrogen levels viz. 150kgN ha^{-1} and 180kgN ha^{-1} during both the years. It might be due to the optimum availability of nitrogen, resulting in more synthesis of photosynthesis and a positive source to sink relationship (Zaheen *et al.* 2006 and Islam *et al.* 2008) [20, 10]. Yield attributes thereafter tend to decrease with further increasing the fertilizer levels. Fertilizer application with optimum quantity had profound effect to increase the yield attributing characters which ultimately reflected on grain yield. These findings are in agreement with Sardar *et al.* (1988) [18] and Mandal *et al.* (1986) [15]. Among silicon applications, panicle length, spikelets per panicle and grains per panicle were significantly highest with 15%Si followed by 10%Si but it remained at par with 5%Si. This could be ascribed to the fact that silicon might have improved the photosynthetic activity which enables rice plant to accumulate sufficient photosynthates which increased dry matter production and these together with efficient translocation resulted in more number of these yield attributing characters. Similar results were also obtained by Kim *et al.* 2012 [11]. Different nitrogen levels and silicon applications failed to influence the 1000-grain weight significantly during both the years (Table 1). Similar findings were confirmed by Korshida *et al.* (2011) [12]. Mobasser *et al.* (2008) [16] reported that silicon application does not affect the 1000-grain weight in rice.

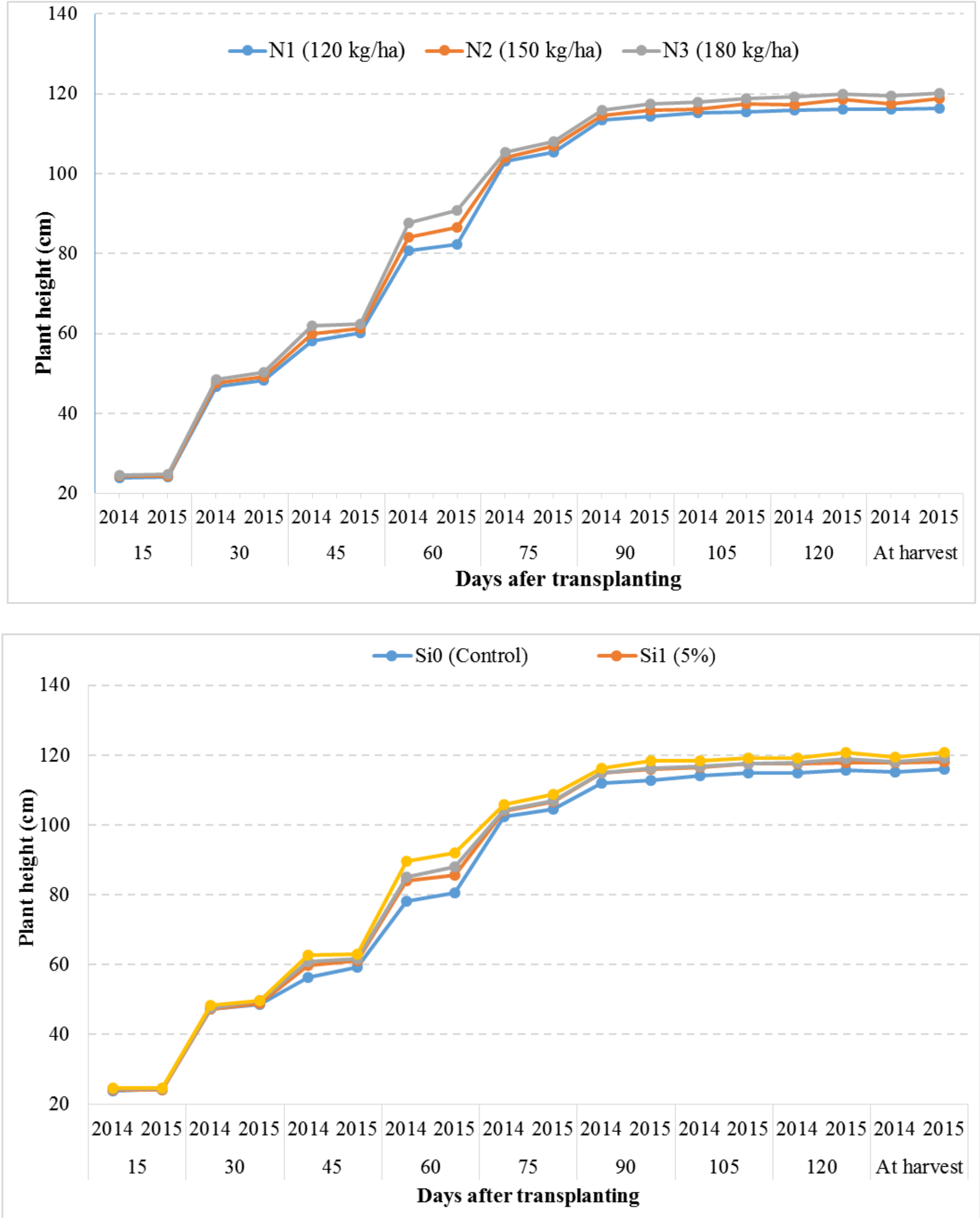
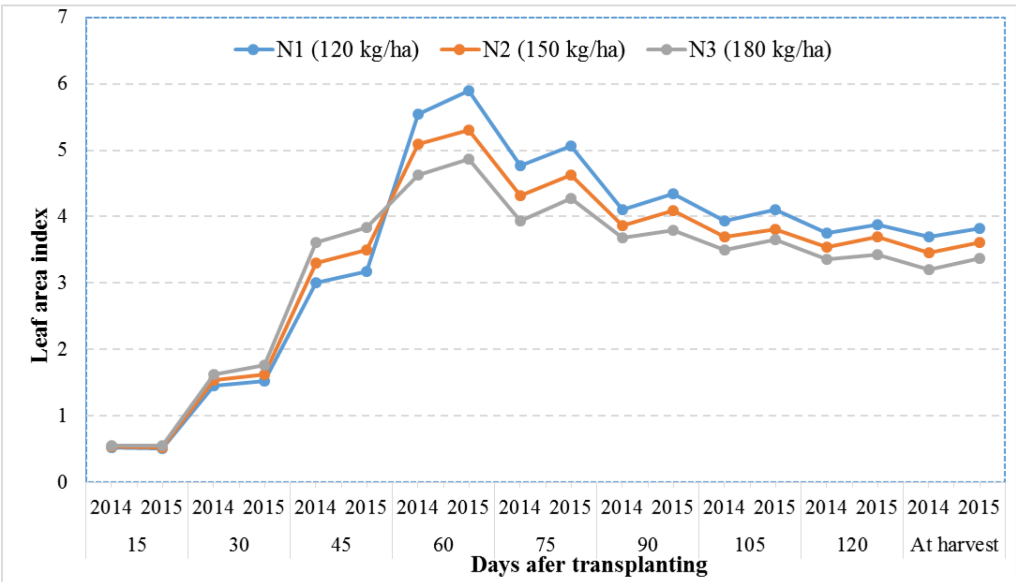


Fig 1: Impact of nitrogen and silicon on plant height of transplanted rice



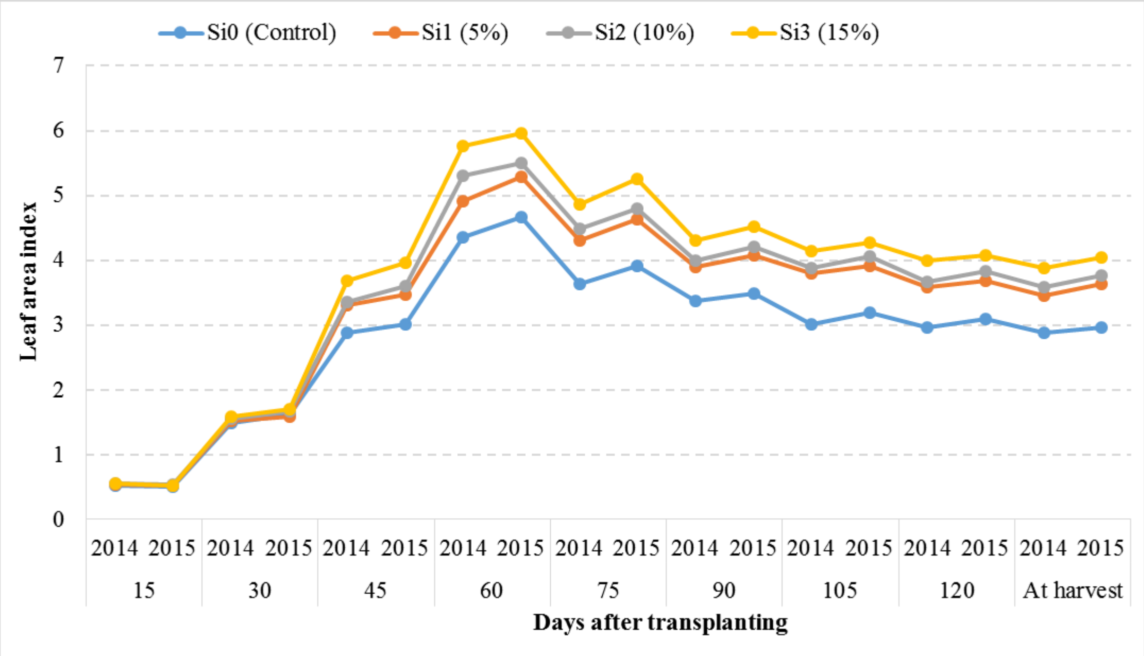


Fig 2: Impact of nitrogen and silicon on leaf area index of transplanted rice

Table 1: Impact of nitrogen and silicon on yield attributes of transplanted rice

Years	2014	2015	2014	2015	2014	2015	2014	2015
Treatments	Panicle length (cm)		No. of spikelets panicle^{-1}		No. of grains panicle^{-1}		1000-grain weight (g)	
	Nitrogen levels (kg ha^{-1})							
120 (N_1)	23.68	23.78	109.87	113.70	80.52	84.22	24.33	24.38
150 (N_2)	23.53	23.59	105.21	108.05	78.52	81.48	24.25	24.28
180 (N_3)	23.36	23.40	100.04	102.30	76.35	79.16	24.12	24.17
SEm±	0.04	0.06	1.44	1.41	0.55	0.53	0.07	0.08
CD($p \leq 0.05$)	0.14	0.19	4.23	4.15	1.62	1.57	NS	NS
	Silicon applications (%)							
Control (Si_0)	23.22	23.29	97.84	98.37	74.53	77.40	24.11	24.15
5 (Si_1)	23.48	23.53	104.47	107.29	78.79	81.71	24.21	24.25
10 (Si_2)	23.61	23.65	106.37	110.05	79.04	82.35	24.26	24.30
15 (Si_3)	23.80	23.89	111.48	116.35	81.49	85.02	24.37	24.42
SEm±	0.05	0.07	1.66	1.63	0.63	0.61	0.08	0.09
CD($p \leq 0.05$)	0.16	0.22	4.89	4.79	1.87	1.81	NS	NS

Conclusion

The two year study indicated that application of nitrogen fertilizer and silicon can significantly regulate plant growth and yield attributes if applied at proper time. It can be suggested that the treatment combination with 120kg N ha^{-1} and 15%Si was found to be the best as it resulted in higher grain yield attributes of rice during both the years.

References

1. Dalling MJ. The physiological basis of nitrogen redistributing during filling in cereals. P.55-71. In J. E. Harper *et al*. (ed.) Exploitation of physiological and genetic variability to enhance crop productivity. American Society of Plant Physiologists, Rockville, MD, 1995.
2. DES. Economic Survey, Directorate of Economics and Statistics. Government of Jammu and Kashmir, 2012-2013; 123:129-130.
3. Dobermann A, Fairhurst T. Field Handbook. Nutritional disorders and nutrient management in rice. International Rice Research Institute (IRRI). Potash and phosphate Institute of Canada (PPIC), 1997, 162. FAO, 2014.
4. Epstein E. Silicon in plants: Facts vs. concepts. In: Silicon in Agriculture. [Ed. L.E. Datnoff, G.H. Snyder and G.H. Korndorfer] Elsevier, Amsterdam, 2002, 1-15.
5. FAO STAT. Production Statistics, Food and Agriculture Organization.
6. Fallah A. Silicon effect on lodging parameters of rice plants under hydroponic culture International Journal of Agriculture Science. 2012; 2(7):630-634.
7. Fageria NK. Yield Physiology of Rice. Journal of Plant Nutrition. 2007; 30:843-879.
8. Fageria NK, Baligar VC. Enhancing Nitrogen Use Efficiency in Crop Plants. Advances in Agronomy. 2005; 88:97-185.
9. Haque KMS, Khaliq QA, Aktar J. Effect of Nitrogen on Phenology, Light Interception and Growth in Aromatic Rice. International Journal of Sustainable Crop Production. 2006; 1(2):01-06.
10. Islam MS, Akhter MM, Rahman MSQ, Banu MB, Khalequzzaman. Effect of nitrogen and number of seedlings per hill on the yield and yield components of *T. Aman* rice (BRRI Dhan 33). International Journal of Sustainable Crop Production. 2008; 3(3):61-65.
11. Kim YH, Khan AL, Shinwari ZK, Kim DH, Waqas M, Kamran M *et al*. Silicon treatment to rice (*Oryza Sativa L. cv 'Gopumbyeo'*) plants during different growth periods and its effects on growth and grain yield. Pakistan journal of Botany. 2012; 44(3):891-897.
12. Khorshida YR, Ardakani MR, Ramezanpour MR,

Khavazi K, Zargari K. Response of yield and yield components of rice (*Oryza sativa* L.) to pseudomonas flouresence and azospirillum lipoferum under different nitrogen levels. American–Eurasian Journal of Agriculture and Environmental Science. 2011; 10(3):387-395.

13. Mae T. Physiological nitrogen efficiency in rice. Nitrogen utilization, photosynthesis and yield potential. Plant and Soil. 1997; 196:201-210.
14. Mallick A. Integrated Nutrient Management in Basmati, Rice–Lentil System under Irrigated Upland Conditions. Ph.D. Thesis (Agron.), Faculty of the Post Graduate School, Indian Agricultural Research Institute New Delhi, India, 1992, 5-34.
15. Mandal SS, Das MAN, Chatterjee BN. Effect of high rates of Potassium and Nitrogen on rice yield components. Environment and Ecology. 1986; 5:300-303.
16. Mobasser HR, Malidareh AG, Sedghi AH. Effect of silicon application to nitrogen rate and spliting on agronomical characterstics of rice (*Oryza sativa* L.). Silicon in Agriculture Conference, Wild Coast Sun, South Africa, 2008, 26-31.
17. Roy BC, Leihner DE, Hilger TH, Steinmueller N. Tillering pattern of local and modern T.Aman varieties as influenced by nitrogen rate and management practices. Journal of Subtropical Agricultural Research and development. 2004; 2(2):6-14.
18. Sardar NA, Shams UAM, Khan NH. Yield components of wetland rice under various sources and levels of nitrogen. Philippines Journal of Crop Science. 1988; 13:155-158.
19. Shashidhar HE, Chandrashekhar N, Narayanaswamy C, Mehendra AC, Prakash NB. Calcium silicate as silicon source and its interaction with nitrogen in aerobic rice. Silicon in Agriculture: 4th International Conference 26-31 October, South Africa: 93, 2008.
20. Zaheen M, Tahir HA, Ehsan SM, Ali RI, Ashraf MM, Ahmad M. Effect of N levels on yield and yield components of Basmati 2000. Journal of Agricultural Research. 2006; 44(2):15-119.