Int.J.Curr.Microbiol.App.Sci (2020) *9*(8): 562-568

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 8 (2020)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2020.908.064

Impact of Nitrogen and Silicon on Yield Attributes and Blast Disease Incidence of Rice under Temperate Kashmir Conditions

Rukhsana Jan[1*], Asha Nabi[2] and Khalid Ul Islam Rather[3]

[1]Division of Agronomy, [2]Division of Plant Pathology, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Srinagar-190025, Jammu and Kashmir, India
[3]Division of Statistics and Computer Science, Sher-e- Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha Jammu-180009, Jammu and Kashmir, India

**Corresponding author*

Keywords

Leaf blast, Neck blast, Nitrogen, Rice and Silicon

Article Info

Accepted:
10 July 2020
Available Online:
10 August 2020

A B S T R A C T

Nitrogen and silicon have been considered beneficial for plant growth and plant health. To assess the effects of nitrogen and silicon on yield attributes and host plant resistance to blast disease in rice, 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%) were used in a factorial experiment in completely randomised block design with four replications. The yield attributes *viz.*, the number of panicles m^{-2} and panicle weight, biological yield and harvest index were significantly highest with 120kg N/ha and 15% Si. Leaf blast and neck blast incidence increased with increase in level of nitrogen whereas it decreased with increased level of Si. Two year study leads to conclusion that treatment combination N_1Si_3 (120kgN ha^{-1} with 15%Si) proved to suitable and economically feasible for increasing yield and disease resistance in transplanted rice under temperate Kashmir conditions.

Introduction

Rice blast caused by *Magnaporthe oryzae* B.C. Couch is one of the major diseases of rice in several rice ecosystems of both tropical and temperate regions. The disease results in heavy yield losses ranging from 35 to 50 per cent and in certain cases, losses were estimated to be as high as 100 per cent (Padmavathi *et al.*, 2005). Although, neck blast is more destructive in terms of yield loss, leaf blast may cause severe damage before plants reach reproductive phase of growth (Seebold *et al.*, 2004).

Nitrogen is an essential nutrient that affects crop growth, yield and quality, required at early and mid tillering stages to maximise the panicle number and during reproductive stage to produce optimum spikelets panicle^{-1} (Sathiya and Ramesh, 2009). Silicon has beneficial role in increasing the crop yield, reduces lodging and in decreasing the incidence of different diseases like rice blast, sheath blight etc as rice being a typical siliciphilous plant.

Although the effect of N on yield has been studied but effect of N and Si on blast incidence has not been studied in Kashmir so far. Thus, present investigation was aimed to study the effect of nitrogen and silicon on yield attributes and blast incidence of rice under temperate Kashmir conditions and to find out a suitable combination of Nitrogen and silicon for optimum crop yield and disease resistance.

Materials and Methods

The experiment was laid out in a factorial completely randomised block design with four replications at Research Farm of Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar during Kharif season, 2014. 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 number of panicles from ten randomly tagged hills of each plot was counted and the number was converted into panicles $m^{-2.}$ Ten randomly selected panicles from each plot were weighed and average weight was calculated and expressed in grams (panicle weight). Biological yield was estimated by adding straw yield to the grain yield. Harvest index was calculated by dividing economic yield with biological yield. The benefit: cost ratio (returns per rupee invested) was determined as: Benefit cost ratio=Net returns/Total cost of cultivation.

We randomly selected six hills per plot, five plants per hill, four leaf per plant (the leaves under flag leaf) and leaf blast incidence were calculated by the following formula at 33 days after transplanting (Seebold et al*;* 2001).

Percentage of leaf blast = number of infected leaves/total number of leaves x100.

We randomly selected fifty panicles per plot and evaluated the incidence of neck blast as per the last node towards the panicle and then obtained percentage of neck blast by the following formula at 70 days after transplanting (Datnoff and Rodrigues, 2005).

Percentage of neck blast = number of infected panicles/total number of panicles x100.

Results and Discussion

The yield attributes *viz.*, the number of panicles m^{-2} and panicle weight were significantly highest with 120kg N/ha followed by 150kgN ha^{-1} (Table 1).It might be due to the optimum availability of nitrogen (with 120kg N/ha), resulting in more synthesis of photosynthesis and a positive effect of source to sink relationship that resulted in higher panicle number and panicle weight (Zaheen *et al.,* 2006). These yield attributes were significantly lowest with 180kgN ha^{-1}. Among different Si applications, yield attributes were significantly highest with 15% Si followed by 10% Si that remained at par with 5% Si. This could be ascribed to the fact that silicon might have been improved the photosynthetic activity which enables rice plant to accumulate sufficient photosynthates that increased dry matter production. In addition, the efficient translocation of photosynthates resulted in more number of panicles and panicle weight. Similar results were also obtained by Kim *et al.,* (2012).

Biological yield and harvest index were significantly highest with 120kgN ha^{-1} and lowest was observed with 180kgN ha^{-1} (Table 1). These findings are in confirmation by Rahman et al (2007). Similarly biological yield and harvest index were significantly highest with 15% Si followed by10%Si being at par with5% Si and significantly lowest was recorded with control. Similar results were endorsed by Pati *et al.,* (2015).

Table.1 Effect of nitrogen levels and silicon applications on yield parameters and blast disease incidence of transplanted rice

Treatments	Number of panicles m^{-2}	Panicle weight (g)	Biological yield (q ha^{-1})	Harvest index (%)	Leaf blast incidence (%)	Neck blast incidence (%)
Nitrogen levels (kg ha^{-1})						
120(N_1)	366.80	2.86	170.95	44.96	19.48	1.39
150(N_2)	361.74	2.83	166.61	44.65	25.62	2.31
180(N_3)	357.57	2.80	157.91	44.11	29.98	2.51
SEm±	1.28	0.006	1.28	0.008	0.71	0.05
CD(P≤0.05)	3.78	0.019	3.84	0.024	2.08	0.16
Silicon applications (%)						
Control (Si_0)	352.57	2.78	154.16	43.96	34.22	2.75
5% (Si_1)	362.49	2.83	165.97	44.35	25.50	2.30
10% (Si_2)	363.70	2.84	168.30	44.56	23.56	2.09
15% (Si_3)	369.39	2.87	172.20	44.92	16.82	1.14
SEm±	1.48	0.007	1.32	0.012	0.82	0.06
CD(P≤0.05)	**4.36**	**0.022**	**3.88**	**0.036**	**2.40**	**0.19**

Table.2 Interaction effect of nitrogen levels and silicon applications on leaf blast incidence of transplanted rice

Treatments	**Silicon applications**			
Nitrogen levels (kg ha^{-1})	**Control (Si_0)**	**5% (Si_1)**	**10% (Si_2)**	**15% (Si_3)**
120 (N_1)	28.74	24.64	20.77	18.28
150 (N_2)	37.81	28.75	22.98	19.77
180 (N_3)	45.13	32.64	32.06	30.10
SEm±	**0.64**			
CD(P≤0.05)	**1.88**			

Table.3 Interaction effect of nitrogen levels and silicon applications on neck blast incidence of transplanted rice

Treatments	**Silicon applications**			
Nitrogen levels (kg ha^{-1})	**Control (Si_0)**	**5% (Si_1)**	**10% (Si_2)**	**15% (Si_3)**
120 (N_1)	2.33	1.87	1.03	0.45
150 (N_2)	3.41	3.18	2.33	1.18
180 (N_3)	3.55	3.42	3.30	2.01
SEm±	**0.12**			
CD(P≤0.05)	**0.37**			

Table.4 Relative economics of transplanted rice as influenced by nitrogen levels and silicon applications

Treatments	Cost of cultivation	Gross returns	Net returns	B:C
N_1Si_0	48522	138929	90407	1.86
N_1Si_1	49146	148280	99134	2.01
N_1Si_2	49490	150174	100684	2.03
N_1Si_3	49834	155941	106107	2.13
N_2Si_0	48687	132364	83677	1.71
N_2Si_1	49311	145581	96270	1.95
N_2Si_2	49655	147330	97675	1.96
N_2Si_3	49999	153206	103207	2.06
N_3Si_0	48852	128447	79595	1.62
N_3Si_1	49476	137549	88073	1.78
N3S2	49820	139223	89403	1.79
N3S3	50164	140566	90402	1.80

Leaf blast and neck blast incidence was significantly low with 120 kg N/ ha followed by 150kgN ha^{-1} and significantly high with 180 kg N / ha (Table 1). Among various Si applications, leaf blast and neck blast incidence decreased with increase in Si concentration.15% Si showed significantly low leaf and neck blast followed by 10%Si and 5%Si. Xu *et al.,* (2006) reported that there is a positive relationship between plant nitrogen content and rice blast incidence. Long *et al.,* (2000) reported that application of nitrogen above the recommended rate for any given cultivar significantly increased disease incidence and total lesion area per plant. However, resistance induced by silicon is the result of increased number of silicified bulliform cells in the epidermis of leaves that act as a physical barrier to impede penetration by *M. grisea* (Ishiguro, 2001) or due to silicon induced enhanced production of phenolics compounds and phytoalexins (Rodrigues *et al.,* 2004). Lemraski (2013) also reported that increase in soil silicon application decreased leaf and neck blast incidence but in our case, the decrease in disease incidence was more because we applied silicon as foliar spray which is more effective than soil application. Interaction between nitrogen levels and silicon applications were significant (Table 2 and 3). Higher blast incidence was achieved in treatment combination 180kgN ha^{-1} and control (N_3Si_0). Significantly lower blast incidence was recorded in treatment combination 120kgN ha^{-1} and 15%Si (N_1Si_3). Similar trend was observed with neck blast.

This may be due to the reason that in treatment combination N_3Si_0' higher dose of nitrogen increases succulence of plant tissues making them more susceptible to blast disease (Xu *et al.,* 2006). However, the treatment combination N_1Si_3 significantly reduced the blast incidence, possibly due to the fact that it provides optimum nitrogen dose to the plant for yield as supported by data in Table 1 and it also provides sufficient silicon to enhance disease resistance. The data relative economics presented in table 4 revealed that benefit cost ratio remained highest Rs. 2.11 when 120kgN ha^{-1} and 15%Si were applied as the treatment recorded the highest net returns and minimum cost of nitrogen fertilizer during the course of investigation.

Higher levels of nitrogen increases susceptibility of rice plants to blast disease and decreases the yield where as increased levels of Si increase host resistance to disease and yield attributes. The treatment combination N_1Si_3 (120kgN ha-1 with 15%Si) proved to be suitable combination to increase the yield and blast disease resistance of rice crop with highest benefit cost ratio in temperate Kashmir conditions.

References

Dantnoff, L.E and Rodrigues, F. A.: The role of silicon in suppressing rice disease. American phytopathological society. 28 pp (2005).

Devi, S. and Sharma, G.D.: Blast disease of rice caused by *Magnaporthe grisea* : A review. *Biol. and Environ. Sci.*, 6, 144-154 (2010).

Ishiguro, K.: Review of research in Japan on the roles of silicon in conferring resistance against rice blast. *Stud. Pl. Sci.*, 8, 277-291 (2001).

Kim, Y. H., Khan, A.L., Shinwari, Z.K., Kim, D.H., Waqas, M., Kamran, M. and Lee, I. J.: Silicon treatment to rice (*Oryza sativa* L. Cv "Gopumbyeo") plants during different growth periods and its effects on growth and grain yield. *Pak. J. Bot*., 44, 891-897 (2012).

Lemraski, M.G.: Silicon and phosphorus facts on blast disease incidence of rice (*Oryza sativa* L.). *Int. J. Farm, Alli. Sci*., 2, 1369-1374 (2013).

Long, D. H., Lee, F. N., and TeBeest, D. O.: Effect of nitrogen fertilization on disease progress of rice blast on susceptible and resistant cultivars. *Plant Dis*., 84,403-409 (2000).

Padmavathi, G., Ram, T., Satyanarayana, K. and Mishra, B.: Identification of blast (*Magnaporthe grisea*) resistance genes in rice. *Curr. Sci.*, 88, 628-630 (2005).

Pati, S., Pal, B. And Badole, S.: Effect of silicon fertilization on growth, yield and nutrient uptake of rice. *Comm. Soil Sci. Pl. Anal.*, 47, 1081-1086 (2015).

Rehman, M.H., Khatun, M.M., Mamun, M.A.A., Islam, M.Z. and I slam, M.R.: Effects of number of seedling per hill and nitrogen levels on growth and yield of BRRI dhan 32. *J. soi. Nat.*, 1, 01-07 (2007).

Rodrigues, F. A., McNally, D. J., Datnoff, L. E., Jones, J. B., Labbe, C., Benhamou, N.,Menzies, J. G., & Belanger, R. R.: Silicon enhances the accumulation of diterpenoid phytoalexins in rice: a potential mechanism for blast resistance. *Phytopath.*, 94, 177-183 (2004).

Sathiya, K. And Ramesh, T.: Effect of split application of nitrogen on growth and yield of aerobic rice. *Asi. J. exp. Sci*., 23, 303-306 (2009).

Seebold, K W, Kucharek, T A., Dantnoff, L.E.Correa-victoria, F.J. and Synder, G. H.: Effect of silicon and fungicides on the control of leaf and neck blast in upland rice. *Pl. Dis*., 84, 871-876 (2004).

Seebold, K W, Kucharek, T A., Dantnoff, L.E.Correa-victoria, F.J. and Marchetti, M A.: T he influence of silicon on components of resistance to blast in succeptible, partially resistant and resistant cultivars of rice. *Phytopath*. 91, 63-69 (2001).

Xu, T., Yi, Z., Li, T., Chao-chun,Z., You-yong, Z. and Fu-suo, Z.: Effects of nitrogen and silicon nutrition on rice blast occurrence under intercropping with different type varieties. *Chi. J. Rice. Sci*. 20, 663-666 (2006).

Zaheen, M; Tahir, H.A; Ehsan, S. M; Ali, R. I; Ashraf, M. M. and Ahmad, M.: Effect of N levels on yield and yield components of Basmati 2000. *J. Agri. Res.* 44, 15-119 (2006).

How to cite this article:

Rukhsana Jan, Asha Nabi and Khalid Ul Islam Rather. 2020. Impact of Nitrogen and Silicon on Yield Attributes and Blast Disease Incidence of Rice under Temperate Kashmir Conditions. *Int.J.Curr.Microbiol.App.Sci.* 9(08): 562-568. doi: https://doi.org/10.20546/ijcmas.2020.908.064