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RESEARCH ARTICLE

Influence of nitrogenous fertilizer levels, planting density and IDM on severity of sheath blight of rice caused by *Rhizoctonia solani* Kuhn in northern Karnataka

■ **P. Nagaraju and M.K. Naik**

SUMMARY

The study was conducted to know the influence of nitrogenous fertilizer levels, planting density and integrated disease management (IDM) on the severity of sheath blight of rice in northern Karnataka. The results indicated that, application of 200 kg N per ha recorded higher per cent disease index (PDI) of 40.37 per cent. However, increased N application from 100 kg N to 350 kg N per ha resulted in increased PDI from 17.04 to 62.60%, respectively. Minimum PDI (23.33%) and higher grain yield (67.80 q/ha) were recorded at 150 kg N per ha which is the recommended N dosage in Thunga Bhadra Project command area of Karnataka state. Among different planting densities, the system of rice intensification (SRI) method (16 hills/m^2) recorded least PDI (5.00%) and highest grain yield (67.16 q/ha) whereas increased planting density from 20 to 70 hills per m^2 resulted in higher PDI from 6.86 to 45.18 per cent, respectively. However, at 50 hills per m^2, 16.12 PDI was recorded with a grain yield of 60.53 q per ha which is the recommended planting density. In the integrated disease management (IDM) trial, wherein, use of cultivar, IR-64 (moderately resistant variety) with foliar application of fungicide hexaconazole (@0.1%) resulted in minimum PDI of 21.26% with higher grain yield of 71.74 q per ha as against 34.73 PDI and 56.87 q per ha grain yield in Samba mahsuri (susceptible variety).

Key Words : Nitrogen fertilizer, Planting density, IDM, Sheath blight, Rice

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The sheath blight of rice caused by *Rhizoctonia solani* Kuhn has attained serious proportion in recent years owing to mono-cropping and continuous cultivation in irrigated tracts. Its occurrence is observed in almost all rice growing states of India.

Among the various influencing factors resulting in higher incidence of sheath blight in current years are high application of nitrogenous fertilizers, higher plant density per unit area and use of compact susceptible cultivars. Intensive methods of rice cultivation involving early season cultivars, double cropping, use of high doses of nitrogenous fertilizers, higher plant population per unit area and early maturing, short culmed, high tillering and

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compact susceptible cultivars have intensified the severity of the disease in all rice growing areas, thus, creating an urgent need for the management of the disease. It is an outstanding recent example to illustrate how a minor disease can attain major status due to shifting in varietal pattern coupled with modifications in agronomic practices (Reddy, 1993). Therefore, an investigation was carried out to unravel the impact of various levels of nitrogenous (N) fertilizers, planting density and integrated disease management (IDM) on sheath blight severity which is the most devastating disease in Thunga Bhadra Project command area of northern Karnataka.

MATERIAL AND METHODS

Three field experiments were carried out at Agricultural Research Station, Siruguppa, Karnataka, India, during *Kharif* 2006 and 2007 in order to know the influence of different nitrogenous fertilizers levels, different planting densities and IDM practices on the severity of sheath blight of rice in irrigated eco-system of northern Karnataka. The trial on different nitrogenous fertilizers levels was laid out in Randomized Block Design (RBD) with three replications of plot size 5 m x 5m with a spacing of 20 cm x 10 cm and the cultivar used was Samba Mashuri (BPT-5204). Different levels of nitrogen (100, 150, 200, 250, 300 and 350 kg N/ha) in the form of urea with a common dose of phosphorus (75 kg/ha) and potassium (75 kg/ha) were applied in the form of DAP and MOP, respectively. Half of nitrogen was applied as basal dose and the remaining half was applied in two equal splits, one at 30 DAT and the second one at 60 DAT. Entire dose of P and K were applied as basal dose. The per cent disease index was recorded at 75 DAT and 90 DAT. After harvest, grain yield was also recorded from net plot and expressed in q per ha. The trial on different planting densities comprised of seven different planting densities *viz.*, 20, 30, 40, 50, 60, 70 and 16 (SRI method) seedlings per hill with three replications in Randomized Block Design and the cultivar used was Samba Mashuri (BPT-5204) and the trial on IDM comprised of two varieties (V1: IR-64 and V2: Samba Mashuri) as main plots and four treatments as sub-plots with three replications in split-plot design and the disease severity was recorded at 75 and 90 days after transplanting (DAT) by using 0-9 disease rating scale (Anonymous, 1996) and is described below.

0 = No infection

1 = Vertical spread of lesion upto 0-20 per cent plant height.

3 = Vertical spread of lesion upto 21-30 per cent plant height

5 = Vertical spread of lesion upto 31-45 per cent plant height

7 = Vertical spread of lesion upto 46-65 per cent plant height

9 = Vertical spread of lesion lip to 66-100 per cent plant height

The per cent disease index (PDI) was worked out by using the formula given by Wheeler (1969) and the grain yield was recorded from each net plot after harvest of the crop and expressed in quintal per hectare.

$$\text{PDI } Z \frac{\text{Sum of rating}}{\text{Number of plants observed}} \text{ x } \frac{100}{\text{Maximum scale}}$$

RESULTS AND DISCUSSION

The pooled data over two years indicated that, among different nitrogen levels, application of 200 kg N per ha recorded higher per cent disease index (PDI) of 40.37 per cent. However, increased N application from 100 kg N to 350 kg N per ha resulted in increased PDI from 17.04 to 62.60%, respectively. Minimum PDI (23.33%) and higher grain yield (67.80 q/ha) were recorded at 150 kg N per ha which is the recommended N dosage in Thunga Bhadra Project command area. The disease intensity was negligible (2.96 PDI) where no nitrogenous fertilizer was applied which also recorded minimum grain yield (27.71 q/ha) (Table 1 and 2). At 200 kg N /ha the disease incidence was 53-60 per cent at 10 x 10 cm spacing as observed by Srinivasan (1980). However, 60-75 days rice plants were more susceptible to sheath blight (Shanmugham and Jeyarajan, 1988). Sheath blight incidence increased significantly with 0 level to 125 kg N /ha (Rajan, 1986).

Rice crop with a high plant density and closed canopy associated with high nitrogen application favour disease buildup from panicle initiation onwards (Singh *et al.*, 2004). Cu *et al.* (1996) reported that an initial increase in N supply corresponded to an increase in yield, but at the higher N level, a reduction in yield was observed. Roy (1986) tested four slow releasing nitrogen fertilizers on Pusa 2-21 cultivar and observed that sheath blight infection was maximum in rice plants grown with urea. Jeyasekhar and Prasad (1989) reported that sheath rot incidence in rice (IR 50) increased significantly from 45 per cent at 75 kg N/ha to 50 per cent at 125 kg N/ha.

Sarkar *et al.* (1991) observed that minimum disease incidence and maximum yield at spacings of 15 cm and 20 cm. Disease intensity increased with increased dosages of nitrogenous fertilizers (upto 100 kg/ha).

Among different planting densities, the system of rice intensification (SRI) method (16 hills/m^2) recorded least PDI (5.00%) and highest grain yield (67.16 q/ha) whereas increased planting density from 20 to 70 hills per m^2 resulted in higher PDI from 6.86 to 45.18 per cent, respectively. However, at 50 hills per m^2, 16.12 PDI was recorded with a grain yield of 60.53 q per ha which is the recommended planting density in Thunga Bhadra Project command area (Table 3 and 4). In fact, from the present investigation SRI method proved to be the best method of planting density. Lee and Rush (1983) reported that new cultivars require higher fertility level, especially nitrogen, to achieve higher yields. In addition, these cultivars are grown in dense plant stand and they tend to be more compact creating a very favourable microclimate for disease development. Sheath blight

Table 1 : Influence of nitrogen levels on the disease severity of sheath blight of rice

Treatment No.	Treatments details	Per cent disease index (PDI)		
		2006	2007	Pooled
T_1	100 kg N/ha	17.41 (24.58)	16.67 (24.06)	17.04 (24.32)
T_2	150 kg N/ha (Recommended dose)	25.18 (30.08)	21.48 (27.55)	23.33 (28.82)
T_3	200 kg N/ha	46.67 (43.11)	34.07 (35.66)	40.37 (39.40)
T_4	250 kg N/ha	53.33 (46.90)	42.22 (40.52)	47.78 (43.72)
T_5	300 kg N/ha	62.22 (52.07)	44.44 (41.84)	53.33 (46.93)
T_6	350 kg N/ha	72.60 (58.44)	52.60 (46.50)	62.60 (52.47)
T_7	0 kg N/ha	2.22 (8.53)	3.70 (11.09)	2.96 (9.62)
	S.E. $\pm$	0.81	1.17	1.34
	C.D. (P=0.05)	2.50	3.62	3.87

Figures in parenthesis are arcsine values
Note : 'P' and 'K' were applied @ recommended dose of 75 kg each per ha

Table 2 : Influence of nitrogen levels on the grain yield of rice

Treatment No.	Treatments details	Grain yield (q/ha)		
		2006	2007	Pooled
T_1	100 kg N/ha	49.94	60.60	55.27
T_2	150 kg N/ha (Recommended dose)	64.39	71.20	67.80
T_3	200 kg N/ha	57.09	63.67	60.38
T_4	250 kg N/ha	51.27	56.33	53.80
T_5	300 kg N/ha	45.38	51.53	48.50
T_6	350 kg N/ha	37.19	41.37	39.28
T_7	0 kg N/ha	25.17	29.70	27.71
	S.E. $\pm$	5.10	1.52	2.68
	C.D. (P=0.05)	15.71	4.68	7.73

Table 3 : Influence of planting density on the severity of sheath blight of rice

Treatment No.	Treatments details (Planting density)	Per cent disease index (PDI)		
		2006	2007	Pooled
T_1	20 hills/m^2	7.04 (15.34)	6.67 (15.00)	6.86 (15.16)
T_2	30 hills/m^2	10.37 (18.81)	11.48 (19.75)	10.93 (19.25)
T_3	40 hills/m^2	12.60 (20.79)	13.33 (21.37)	12.97 (21.05)
T_4	50 hills/m^2 (Recommended planting density)	15.56 (23.26)	16.67 (24.03)	16.12 (23.60)
T_5	60 hills/m^2	24.44 (29.60)	25.18 (30.10)	24.81 (29.85)
T_6	70 hills/m^2	47.03 (43.30)	43.33 (41.17)	45.18 (42.23)
T_7	SRI method (16 hills/m^2)	3.70 (10.90)	6.30 (14.54)	5.00 (12.92)
	S.E. $\pm$	0.42	0.63	0.41
	C.D. (P=0.05)	1.28	1.93	1.20

Figures in parenthesis are arcsine values

fungus is known to encircle the sheath region horizontally to widen its infection to more number of plants and further they spread upward reaching the panicle and earhead. More number of hills (70 hills/m^2) must have helped to extend the horizon of infection leading to higher incidence. Srinivasan (1980) recorded 16 to 27 per cent

Table 4 : Influence of planting density on grain yield of rice

Treatment No.	Treatments details (Planting density)	Grain yield (q/ha)		
		2006	2007	Pooled
T_1	20 hills/m^2	40.80	42.60	41.70
T_2	30 hills/m^2	49.31	51.03	50.17
T_3	40 hills/m^2	54.64	56.20	55.42
T_4	50 hills/m^2 (Recommended planting density)	59.56	61.51	60.53
T_5	60 hills/m^2	52.53	54.85	53.70
T_6	70 hills/m^2	45.05	47.00	46.03
T_7	SRI method (16 hills/m^2)	66.70	67.63	67.16
	S.E. $\pm$	1.83	1.91	1.19
	C.D. (P=0.05)	5.63	5.90	3.42

Table 5 : Integrated management of sheath blight of rice with two varieties

Treatment No.	Treatments details	Per cent disease index								
		2006			2007			Pooled		
		V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean
T_1	Hexaconazole 5EC @ 0.1%	21.09 (27.26)	13.84 (21.82)	17.46	19.42 (26.09)	13.29 (21.37)	16.35	20.12 (26.67)	13.60 (21.59)	16.86
T_2	Achook (0.15% Azadirachtin) @ 0.5%	30.67 (33.64)	19.82 (26.16)	25.24	31.79 (34.29)	15.66 (23.07)	23.72	31.20 (33.96)	17.41 (24.62)	24.30
T_3	*P. fluorescens* (Pfr-1) @ 0.5%	38.20 (38.17)	23.64 (29.08)	30.92	39.56 (38.97)	24.85 (29.78)	32.21	39.10 (38.67)	24.22 (29.44)	31.66
T_4	Untreated check	47.67 (43.66)	30.15 (33.28)	38.91	49.32 (44.59)	29.44 (32.85)	39.38	48.52 (44.52)	29.81 (33.06)	39.16
	Mean	34.41	21.86	28.13	35.02	20.81	27.92	34.73	21.26	27.99
		C.D. (P=0.05)	CV (%)		C.D. (P=0.05)	CV (%)		C.D. (P=0.05)	CV (%)	
	Main (Variety)	1.46	6.30		1.99	7.30		1.14	6.20	
	Sub (Treatment)	2.07	-		2.82	-		1.60	-	
	Interaction									
	M x S	2.93			3.98			2.27		

Figures in parenthesis are arcsine values
Note: V_1 - Variety Samba mahsuri V_2 - Variety IR-64

Table 6 : Integrated management of sheath blight of rice for grain yield with two varieties

Treatment No.	Treatments details	Grain yield (q/ha)								
		2006			2007			Pooled		
		V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean
T_1	Hexaconazole 5 EC @ 0.1%	78.17	85.13	81.80	81.21	88.43	84.82	79.69	86.93	83.31
T_2	Achook (0.15% Azadirachtin) @ 0.5 %	55.32	69.88	62.60	57.70	71.08	64.39	56.51	70.48	63.50
T_3	*P. fluorescens* (Pfr-1) @ 0.5%	50.63	66.63	58.63	52.22	67.31	59.76	51.42	66.97	59.20
T_4	Untreated check	38.61	60.83	49.58	41.41	64.26	52.83	39.86	62.59	51.22
	Mean	55.61	70.62	63.15	58.13	72.77	65.45	56.87	71.74	64.31
		C.D. (P=0.05)	CV (%)		C.D. (P=0.05)	CV (%)		C.D. (P=0.05)	CV (%)	
	Main (Variety)	1.68	4.10		2.27	4.22		3.35	3.81	
	Sub (Treatment)	2.37	-		3.21	-		1.91		
	Interaction									
	M x S	2.35			4.54			2.70		

Note: V_1 - Variety Samba mahsuri V_2 - Variety IR-64

sheath blight incidence at 10 x10 cm spacing and 2 to 3 per cent at 20 x 20 cm spacing. No sheath blight incidence was recorded at 30 x 30 and 40 x 40 cm spacing. The findings are interesting to compare and contrast at various levels.

In the integrated disease management (IDM) trial, wherein, use of cultivar, IR-64 (moderately resistant variety) with foliar application of fungicide hexaconazole (@0.1%) resulted in minimum PDI of 21.26% with higher grain yield of 71.74 q per ha as against 34.73 PDI and 56.87 q per ha grain yield in Samba mahsuri (susceptible variety) (Table 5 and 6).

Surulirajan and Kandhari (2005) reported that *Trichoderma viride* + carbendazim 50 WP (0.1%) spray along with soil amendments (FYM + Saw dust) showed maximum reduction in sheath blight severity and higher grain yield. Manibhushanrao and Baby (2000) reported that combination of fungal antagonists and soil amendments and VAM fungi and soil amendments not only significantly controlled the sheath blight but also improved the growth of rice plants. Prasad *et al*. (2010) studied integrated management practices for managing sheath blight of rice and reported that application of 2/3 recommended dosages of nitrogen with two sprays of propiconazole 125g ai/ha reduced the disease severity and incidence and resulted in more grain yield.

From the above experimental results, it could be concluded that 150 kg N/ha, 50 seedlings and 16 seedlings/hill (SRI method) and use of variety IR-64 with foliar spray of hexaconazole were found good for effective management of sheath blight disease in rice.

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