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Effect of different fungicides on blast disease of rice caused by *Magnaporthe grisea* at different nitrogen levels.

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ABSTRACT

Evaluation of different fungicides and their interaction with nitrogen against rice blast disease was carried out during *rabi* season of 2008 and 2009 at Agricultural rice research station in Nellore, Andhra Pradesh. A highly susceptible rice variety Nellore Mashuri NLR 34242 was planted in split plot design and the application of various fungicides namely Kasugamycin 3 SL @ 2.5 ml/l, Tricyclazole 75 WP @ 0.6 ml/l, Isoprothiolane 40 EC @ 2 ml/l in combination with nitrogen doses 0,120,160,200and 240 kg/ha were taken up. All the fungicides proved to be effective in the management of rice blast disease but tricyclazole proved effective in all the three sprays in reducing the leaf blast disease percentage to 6.9% in 2008 and 9.5% in 2009. The control of disease in case of neck blast was also shown by tricyclazole with 11.0% in 2008 and 17.1% in 2009.

Keywords: Fungicides, Blast disease, rice.

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INTRODUCTION

"Rice is life" the theme of International Year of Rice, 2004 that reflected the importance of rice (Oryza sativa L.), which holds the key to our country's ability to produce enough food for our people. For Indian population; 130 million tons of rice yields have to grow at a target, the rice yields have to grow at a rate of 1.8% per annum for India. The development of need based cost effective plant protection measures for effective management of rice diseases is the need of the future for higher and sustainable rice yield (Anonymous, 2006). Among the biotic stresses, it is often mentioned that diseases caused by various micro organisms, take a heavy losses of the crop in the humid tropical rice growing environment which on an average yield loss span from 5 to 15% over large areas, total crop failure due to pests and disease epidemics are regularly encountered in some or the other pockets of the country (Reddy *et al.,* 2004). Blast of rice caused *by Magnaporthe grisea* (Hebert) Barr is an important disease of rice, which accounts for serious yield losses in all rice growing areas of the country. Bhat (1988) reported more than 65 percent loss in yield in the susceptible rice cultivars.

The most usual approaches for the management of rice blast disease include planting of resistant cultivars, application of fungicides and manipulation of planting times, fertilizers and irrigations (Georgopoulos and Ziogas, 1992). The work on chemical control has been in progress in India from the beginning of this century and several chemicals and spray schedules have been suggested for control of blast (Saikia, 1991; Kumbhar, 2005). This paper reports on the influence of various fungicides with the interaction of nitrogen on the management of rice blast disease and their impact on rice yield.

MATERIALS AND METHODS

Field experiments were conducted at Agricultural Rice Research station, Nellore during *rabi* season 2008-09 & 2009-10. The experimental site is situated at an altitude of 182.90 m above mean sea level with $14^0$27' N latitude and $79^0$59'E longitude.

The mean annual rainfall in this area in the past ten years was about 1052.02 mm. During 2008-10, total rainfall recorded was 1080.77 mm with 81 Rainy days. The details of the materials used and the methodology adopted during this investigation are described here under.

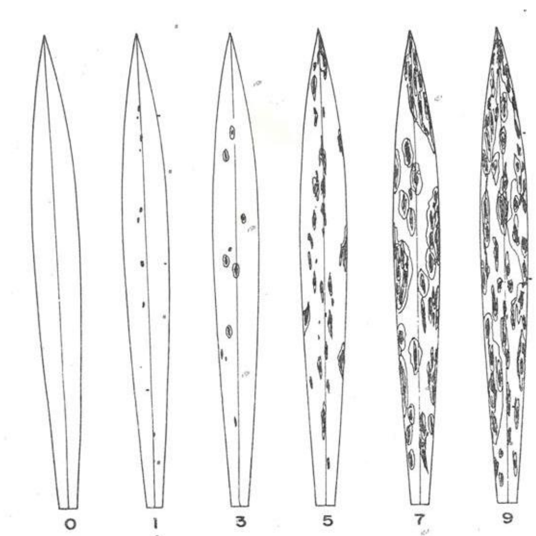
A susceptible rice variety, NLR 34242 (Nellore Mashuri) was used in this trail. The experiment was laid in split plot design with two factors that is fungicides and nitrogen interaction and the treatments including untreated check, replicated thrice. Each plot measured 7.26 m^2 with a spacing of 15x15 cm with bunds all around the plots. Replications were separated with a gap of 1 meter for irrigation channels. The rice variety Nellore Mashuri (NLR 34242) was planted with recommended package of practices except plant protection. Uniform dose of 60 kg P_2O_5 (SSP) and 40 Kg K_2O per hectare (MOP) was applied in the form of urea in three split doses 1/3 at basal, 1/3 at active tillering stage and 1/3 at panicle initiation stage as per the treatments. No artificial inoculations were made, as natural inoculum was sufficient to cause disease. The treatment consists of kasugamycin 3 SL @ 2.5 ml/l, tricyclozole 75 WP @ 0.6 ml/l in combination with nitrogen doses 0,120,160,200,240 kg/ha were taken up. Three sprayings of chemicals were done, first spraying was given 30 days after transplanting when the incidence of leaf blast disease crossed the Economic Threshold Level in the experimental plots. Only water was sprayed for the untreated check. Weeds were controlled by hand picking.

Leaf blast was calculated by selecting 50 hills randomly in four corners and middle of the plot. The third leaf from the top in each tiller was taken and the disease severity was noted as disease score from 0-9 scale (Anonymous, 1980). Then it was averaged and calculated the percent disease incidence using the following formula.

$$\text{PDI (Percentage Disease Incidence)} = \frac{\text{Average Score}}{\text{Maximum Score}} \text{X}100$$

The observations were recorded thrice, *i.e.,* before spraying of fungicides and two times after spraying of fungicides at 10 days intervals.

0-9 Scale to calculate leaf blast



Neck blast was calculated by selecting 20 hills randomly in four corners and middle of the plots and counted the number of affected panicles per hill. Percentage of neck blast was calculated by dividing the affected number of panicles per hill to the total number of panicles per hill.

The data were subjected to statistical analysis and were tested at five percent level of significance to interpret the treatment differences.

RESULTS

The leaf blast (%) data was recorded in this experiment at periodic intervals on 30 DAT, 40DAT and 50 DAT for *rabi* 2008.

Incidence of leaf blast was recorded at periodic intervals and pre-treatment count prior to first spraying (30 DAT) indicate that the leaf blast disease in all the fungicidal treatments was uniform without any significant differences including untreated check. However in the plots that received varied nitrogen levels there were differences with regard to blast incidence. There was a progressive increase of leaf blast incidence with additional doses of nitrogen application but there were no significant differences. Even the interaction effects were non-significant.

Table-1 Interaction of different fungicides on leaf blast disease (%) at different nitrogen levels (*rabi* 2008-2009) (40 DAT)

S.NO	FUNGICIDES	NITROGEN LEVELS kg/ha					MEAN
		0	120	160	200	240	
1	UNTREATED CHECK	42.6	48.2	50.1	57.7	60.9	51.9
2	KASUGAMYCIN	14.2	20.6	25.2	30.8	33.1	24.7
3	TRICYCLAZOLE	9.0	12.4	16.9	19.3	23.5	16.2
4	ISOPROTHIOLANE	16.7	22.9	27.0	32.0	35.2	26.7
	MEAN	20.6	26.0	29.8	34.9	38.1	
		S.E.M	C.D@5%	C.V%			
	FUNGICIDES	0.8	3.0	9.8			
	NITROGEN	1.1	4.9	7.4			
	INTERACTION	1.5	4.7	7.4			

The post-treatment count after first spray at 10 days after spraying (40DAT) (table-1) clearly revealed that Tricyclazole @ 0.6g/l was significantly superior in reducing leaf blast incidence (16.2%) followed by Kasugamycin and Isoprothiolane which were *on par*. In untreated check the leaf blast incidence was at 51.9%. Regarding nitrogen levels, there was significant progressive increase in leaf blast disease incidence with zero nitrogen level recording the lowest incidence of 20.6%. As nitrogen quantity increased the efficacy of chemicals was also undermined with 240 kg/ha of nitrogen recording 38.1% leaf blast incidence. The interaction between fungicides and nitrogen showed that tricyclazole at zero nitrogen recorded less disease incidence. The higher disease incidence was observed in untreated check plots with 240 kg/ha of N. The percent disease reduction over control for the treatments 10 days after first spraying recorded higher disease reduction percent in tricyclazole (75%) than other two fungicides.

The data recorded at 10 days after second spray (50 DAT) (table-3) indicated that the leaf blast disease was significantly reduced due to the fungicides tricyclazole, kasugamycin and isoprothiolane when compared to untreated check. As in first spray tricyclazole treatment was significantly higher when compared to the other two fungicides. The leaf blast disease incidence was significantly higher in all the nitrogen levels (120 to 240 kg/ha) when compared to zero nitrogen level. However, there was significant progressive increase in leaf blast disease incidence with addition of increased nitrogen. The interaction between the main and sub treatments were significant indicating that tricyclazole was more effective at zero nitrogen (3.8%). On contrary the higher leaf blast was observed with untreated check at 240 N level with 65.4% leaf blast incidence. The percent disease reduction over control for the treatments 10 days after first spraying recorded higher disease reduction percent in tricyclazole (61%) than other two fungicides.

Table- 2 Interaction of different fungicides on leaf blast disease (%) at different nitrogen levels (*rabi* 2009-2010) (40 DAT)

S.NO	FUNGICIDES	NITROGEN LEVELS kg/ha					MEAN
		0	120	160	200	240	
1	UNTREATED CHECK	44.2	52.9	55.0	59.3	63.7	55.0
2	KASUGAMYCIN	16.3	21.4	22.8	28.8	33.1	24.4
3	TRICYCLAZOLE	10.4	13.2	16.0	19.3	22.8	16.3
4	ISOPROTHIOLANE	18.0	23.7	25.3	30.6	35.0	26.5
	MEAN	22.2	27.8	29.7	34.5	38.6	
		S.E.M	C.D@5%	C.V%			
	FUNGICIDES	1.8	3.4	10.1			
	NITROGEN	0.8	2.4	12.3			
	INTERACTION	1.0	3.4	12.3			

Table-3 Interaction of different fungicides on leaf blast disease (%) at different nitrogen levels (*rabi* 2008-2009) (50 DAT)

S.NO	FUNGICIDES	NITROGEN LEVELS kg/ha					MEAN
		0	120	160	200	240	
1	UNTREATED CHECK	49.3	53.6	56.2	61.9	65.4	57.3
2	KASUGAMYCIN	5.6	10.8	12.5	15.6	18.7	12.6
3	TRICYCLAZOLE	3.8	7.3	9.5	13.2	15.2	6.9
4	ISOPROTHIOLANE	7.2	11.3	14.1	18.5	21.8	14.6
	MEAN	16.5	20.7	23.1	27.3	30.3	
		S.E.M	C.D@5%	C.V%			
	FUNGICIDES	0.8	3.0	9.8			
	NITROGEN	0.6	3.0	6.1			
	INTERACTION	0.9	3.0	6.1			

The percent reduction of disease over control in 10 days after second spraying indicated 61% of disease reduction in tricyclazole treatment followed by kasugamycin 54% and isoprothiolane 50%. Percent disease increase in nitrogen levels showed a progressive increase in disease from 120 to 240 kg N/ha when compared with zero nitrogen level. The leaf blast percent decreased from 10 DAFS to 10 DASS. It ranged from 29% to 37%.

The leaf blast (%) data were recorded at periodic intervals on 30 DAT, 40DAT and 50 DAT for *rabi* 2009.

The pre-treatment count recorded at 30DAT indicates that the leaf blast disease was *on par* in all the fungicidal treatments. Moreover, initially there were no significant differences in leaf blast disease among different nitrogen levels from 0 to 240 kg/ha.

The post-treatment count recorded at 40DAT (10DAFS) (table-2) indicated that all fungicidal treatments have reduced leaf blast incidence compared to control. Among the fungicides tricyclazole recorded lowest leaf blast with 16.3% incidence followed by kasugamycin and isoprothiolane which were *on par*.

Regarding nitrogen levels there was an increase in leaf blast as nitrogen level increased. It ranged from 22.2% to 38.6%. Nitrogen treatments 120 kg N/ha and 160 kg N/ha were *on par*. The interaction between fungicides and nitrogen indicated a lower disease incidence in tricyclazole at 0 N level and higher leaf blast was observed in untreated check at 240 N level. The percent disease incidence was observed to increase from 0 to 240 kg N/ha with the nitrogen doses 120 kg/ha and 160 kg/ha being *on par*. Highest incidence of 38.6% was in the plots that received 240 kg N/ha.

The percent disease reduction over control after first spray revealed that tricyclazole showed 74% of disease reduction followed by other two fungicides namely kasugamycin and isoprothiolane which were *on par*.

Table-4 Interaction of different fungicides on leaf blast disease (%) at different nitrogen levels (*rabi* 2009-2010) (50 DAT)

S.NO	FUNGICIDES	NITROGEN LEVELS kg/ha					MEAN
		0	120	160	200	240	
1	UNTREATED CHECK	52.5	56.3	59.1	64.3	68.7	60.1
2	KASUGAMYCIN	9.0	12.2	14.3	18.8	22.4	15.3
3	TRICYCLAZOLE	3.3	7.1	9.6	12.3	15.2	9.5
4	ISOPROTHIOLANE	11.0	14.2	17.3	20.8	25.3	17.7
	MEAN	17.3	20.9	23.4	27.4	30.9	
		S.E.M	C.D@5%	C.V%			
	FUNGICIDES	1.2	3.3	11.1			
	NITROGEN	0.9	3.0	7.3			
	INTERACTION	1.0	7.3	7.3			

The post-treatment count after second spray (50 DAT, table 4) also project results similar to that of first spray with tricyclazole treatment recording significantly less leaf blast incidence (9.5%) followed by kasugamycin and isoprothiolane treatments that were *on par*. With record to nitrogen doses also the results were concurrent with that of first spray revealing positive correlation between nitrogen application and disease incidence. The interaction effect highlighted that under low nitrogen levels fungicides proved better with 17.3% leaf blast incidence in zero nitrogen plots that gradually increased to30.9% under 240 kg N/ha.

The percent disease reduction over control after second spraying indicated that among fungicides tricyclazole showed 47% of disease reduction compared to other fungicides. The next best was kasugamycin but however was *on par* with isoprothiolane.

The results of consecutive years namely *rabi* 2008 and 2009 clearly revealed that the fungicides have reduced the disease significantly compared to untreated check while low levels of nitrogen (120kg N/ha) clearly showed a lower percent of disease incidence in both the years when compared to the high levels of nitrogen (200 - 240 kg N/ha). The best result was observed in the treatment tricyclazole @0. 6 g/lit at zero nitrogen level.

Neck blast (%) data was recorded at milky stage of the crop (60DAT) during *rabi* 2008 & 2009 and presented in tables 5 and 6.

Table-5 Interaction of different fungicides on neck blast disease (%) at different nitrogen levels (*rabi* 2008-2009)

S.NO	FUNGICIDES	NITROGEN LEVELS kg/ha					MEAN
		0	120	160	200	240	
1	UNTREATED CHECK	26.2	31.8	35.7	41.3	46.0	36.2
2	KASUGAMYCIN	12.9	17.5	20.4	25.1	28.3	20.8
3	TRICYCLAZOLE	3.2	7.7	10.7	15.2	18.4	11.0
4	ISOPROTHIOLANE	15.3	22.0	24.8	29.4	33.1	24.6
	MEAN	14.4	19.7	22.9	27.7	31.4	
		S.E.M	C.D@5%	C.V%			
	FUNGICIDES	3.9	9.4	12.3			
	NITROGEN	1.6	4.0	11.6			
	INTERACTION	1.5	11.6	11.6			

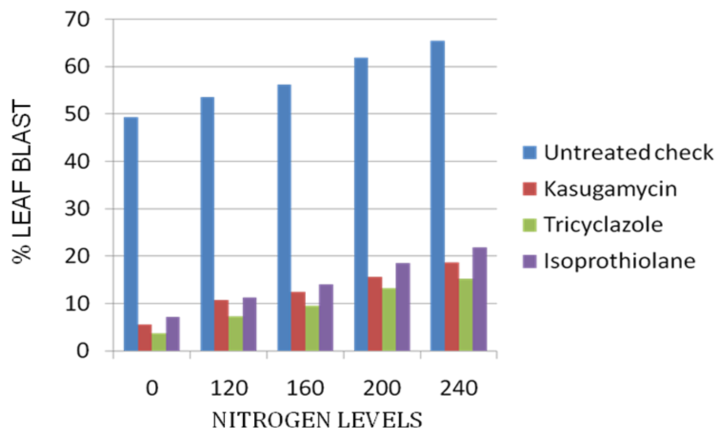
Table-6 Interaction of different fungicides on neck blast disease (%) at different nitrogen levels (*rabi* 2009-2010)

S.NO	FUNGICIDES	NITROGEN LEVELS kg/ha					MEAN
		0	120	160	200	240	
1	UNTREATED CHECK	31.4	37.1	40.2	48.5	53.5	41.5
2	KASUGAMYCIN	18.4	22.4	26.3	32.4	37.5	27.6
3	TRICYCLAZOLE	8.2	13.3	16.1	22.5	25.4	17.1
4	ISOPROTHIOLANE	20.9	27.2	31.3	38.1	41.0	31.7
	MEAN	19.7	25.0	28.5	35.4	39.3	
		S.E.M	C.D@5%	C.V%			
	FUNGICIDES	4.2	8.2	12.3			
	NITROGEN	1.7	4.8	14.2			
	INTERACTION	2.0	5.0	14.2			

During *rabi* 2008 neck blast disease was significantly reduced to the fungicides tricyclazole, kasugamucin and isoprothiolane when compared to untreated check. Among all the fungicides tricyclazole was superior in controlling neck blast (11.0%) which was followed by kasugamycin (20.8%) and isoprothiolane (24.6%) which were *on par*.

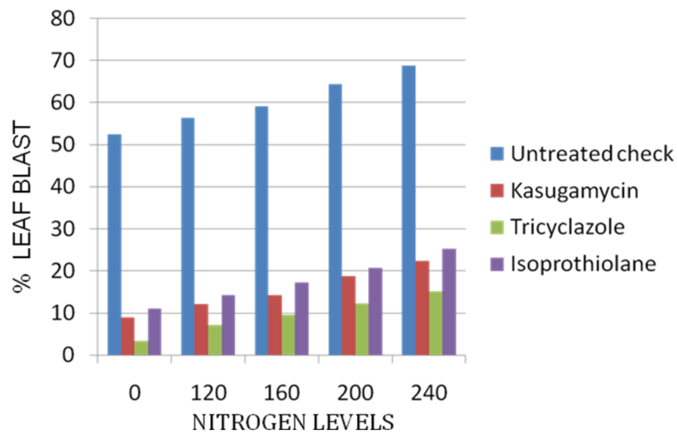
Graph-1

Interaction of different fungicides on leaf blast disease (%) at different nitrogen levels (*rabi* 2008-2009) (50 DAT)



Graph-2

Interaction of different fungicides on leaf blast disease (%) at different nitrogen levels (*rabi* 2009-2010) (50 DAT)



Regarding different doses of nitrogen, plots with zero level nitrogen recorded significantly lowest neck blast incidence (14.4%) which gradually increased as nitrogen doses increased significantly higher neck blast was observed in the treatment 240 kg N/ha (31.4%).

During *rabi* 2009, tricyclazole @ 0.6 g/lit treatment was the best and significantly superior to other treatments including untreated check. Even there were significant differences in neck blast incidence at varied nitrogen levels *i.e.,* 120 kg N/ha to 240 kg N/ha irrespective of fungicidal treatments.

Neck blast incidence during both the years exhibited the same trend. Tricyclazole proved to be the best in controlling neck blast than other fungicides. The interaction between fungicides and nitrogen during both the years exhibited lowest disease incidence in tricyclazole at 0 N level while highest incidence was in untreated check at 240 N level.

The field experiment showing the effect of fungicides on the rice variety NLR 34242.

DISSCUSION

In the present investigation, arrays of systemic fungicides in combination with different nitrogen levels are evaluated to prevent or delay air-borne foliar infections by the blast pathogen.

Three fungicides namely Tricyclazole, Kasugamycin and Isoprothiolane were tested against leaf blast and neck blast diseases at different nitrogen levels (0,120,160,200&240 kg N/ha). The leaf blast disease incidence at pre- treatment count prior to first spraying indicate that the leaf blast disease in all the fungicidal treatments was uniform without any significant differences including untreated check. Nitrogen levels showed differences with regard to blast incidence. There was a progressive increase of leaf blast incidence with additional doses of nitrogen application, but there were no significant differences. Even the interaction effects were non-significant during the two years of the experiment.

The present studies clearly showed that Tricyclazole was the best fungicide in reducing leaf blast followed by kasugamycin and isoprothiolane. With regard to nitrogen application, a positive correlation was noticed. As the dose of nitrogen increased it resulted in increased leaf blast incidence. Similar was the results even for neck blast incidence. Neck blast disease was significantly reduced by the fungicides *viz.,* tricyclazole, kasugamycin and isoprothiolane when compared to untreated check during both the years among all the fungicidies tricyclazole was superior in controlling neck blast 11.0%(2008) and 17.1%(2009) which was followed by kasugamycin 20.8%(2008) and 27.6% (2009) and isoprothiolane 24.6% (2008) and 31.7%(2009).

Regarding N levels, treatment with zero level nitrogen recorded significantly lowest neck blast incidence during the two years *i.e.,* 14.4% and 19.7% which gradually increased as nitrogen doses increased. Significantly higher neck blast was observed in the treatment 240 kg N/ha with 31.4% and 39.3% during 2008 & 2009 respectively.

Similar results' regarding the efficacy of various fungicides has been reported by different researchers throughout the world. For instance Varier *et al.* (1993) eight fungicides for management of rice blast and inferred that seed treatment with Tricyclazole @ 4 kg/kg seed was the most effective chemical up to 40 days after sowing. Tirmali *et al.* (2001), Sharma *et al. (*2002) and Gohel *et al.* (2009), Dubey (2005) proved Tricyclazole significantly superior in decreasing leaf & neck blast and increasing the no of tillers there by increasing the yield attributes.

Kasugamycin and Isoprothiolane also controlled leaf and neck blast disease incidence (Anwar *et al.*, 2005 Mandal *et al*., 2008)

Bragantia (2010) conducted a field experiment to study the effect of N fertilizer on the incidence of rice blast. Nitrogen levels (0, 50,100 and 150 kg N/ha) were placed in the plots. The incidences of rice blast in seeds as well as the panicle disease severity were significantly higher in plants fertilized with N. The results of the study suggest that the use of fungicides is necessary when rice cultivars susceptible to blast are fertilized with nitrogen.

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