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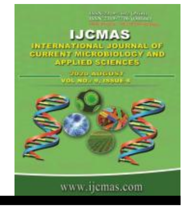

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Screening of Disease Incidence in Rice Cultivars against *Pyricularia oryzae* in Talwandi Sabo, Punjab, India

Nalini Singh* and Jasvir Singh Brar

Guru Kashi University, Sirsa-Sardulgarh Rd, Talwandi Sabo, Punjab 151302, India

**Corresponding author*

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ABSTRACT

The rice blast affects the leaves on which it causes diamond-shaped white to gray or reddish-brown lesions with reddish to brown borders. In this paper, authors have identified the rice blast caused by *Pyricularia oryzae* using five rice cultivars growing in Malwa region of Punjab and study the incidence and intensity of leaf, neck and panicle blast of rice. The surveillance was carried on tillering and around flowering stages. The highest leaf blast and incidence was 80.0%, 19.0% recorded, whereas the lowest was 21.0%, 14.0% observed. The rice blast shows the occurrence for the disease having the ideal predisposing conditions.

Introduction

Rice *(Oryza sativa)* is one of the most important cereal crops in India as in area, production and productivity. Almost 90% of the rice is grown and consumed in Asia (1). A Rice blast caused by *Pyricularia oryzae* Cavara synonym *Pyricularia grisea* Sacc. The anamorph of *Magnaporthe grisea* (Herbert), is one of the most destructive and wide spread disease (2). This disease has caused significant yield losses in many rice growing countries e.g. 75% loss grains in India (3). It affect all above ground parts of a rice plant leaf, collar, node, neck, parts of panicle and some time leaf sheath. Paddy Blast identify by initial symptoms appear as white grey-green lesion or spots, with dark green border. Older lesions on the leaves are elliptical or spindle shaped and whites to gray centres with red to brownish or necrotic border (4). The pathogen manifests itself at the seedling, tillering and flowering stages of crop growth causing losses on account of leaf-, node- and neck-blast in the state (5). Frequent epiphytotics of the disease in the state for the last about fifteen years have been inflicting heavy qualitative and quantitative losses to the farmers. The application of excessive nitrogenous fertilizers, low night temperature (20º- 240ºC), dew deposition on leaves (RH >90%) and water stress at panicle emergence stage have also been found to favour the disease development (6). The disease cycle of rice blast involves three distinct phases: infection (germination of conidia), colonisation of mycelium, and sporulation (7). The present study has analysed and identification of rice blast i.e. incidence and intensity.

Materials and Methods

Description of the study area

The survey was conducted during 2017/18 cropping season of one major rice growing at Talwandi Sabo, Bathinda i.e. Malwa region of Punjab. The site is South-western part of Punjab and north western India in the Malwa Region. The annual rainfall, average minimum and maximum temperature of Talwandi Sabo Bathinda is 20 mm to 40 mm, 15 °C and 45 °C, respectively.

Survey of Rice Diseases

Surveys were conducted during September and October 2017/2018 to determine the incidence and distribution of rice diseases in Talwandi Sabo, Bathinda.

Disease Assessment

During study of Rice blast (*Pyricularia Oryzae)*, the collected symptoms from the leaf, neck and panicle regions of the plant showing the typical blast symptoms in rice growing area of Guru Kashi University, Talwandi Sabo fields during September-October 2017 and 2018 crop seasons. The leaf blast incidence was recorded by tillering and around flowering stages assessing upper three leaves of each random tiller from field and expressed as per cent for each plot (8). The observations are on symptomatology, disease incidence and severity of disease were recorded on rice plants in the field. The data on disease severity were recorded on plants in 1sq meter area at four corners as well as in the centre of the field. Disease severity was recorded on 0 – 9 scale (IRRI 1996) as follows:

The figure 1 shows the rice blast grading as per IRRI, 1996 and used in identification of intensity and incidence in rice plant.

The method of growing of various verities of rice i.e. V1 (PR114), V2(PR126), V3(PR124), V4 (PB1121) and V5(PR122) using LSD shown in figure 2.

Leaf Blast Incidence

The lesions due to this disease appear on leaves. The tips of leaf lesions are typically spindle-shaped to diamond-shaped spots, wide in the center and pointed at the ends (Figure 3). In table 1, the Leaf Blast Incidence was recorded by assessing upper three leaves of each random tiller from each of the ten random hills from each field and expressed as per cent for each location (5).

$$\text{Disease incidence (\%)} = \frac{\text{No.of diseased leaves} \times 100}{\text{Total no.leaves assessed}}$$

Leaf Blast Intensity

The Leaf Blast Intensity was calculated using the following formula:

$$\text{Leaf Blast Intensity (LBI)(\%)} = \frac{\sum nV \times 100}{N \times \text{maximum grade value}}$$

Where

PDI = Per cent disease intensity
V = Disease score
n = Number of leaves showing a particular score
N = Total number of leaves

examined/assessed

Neck Blast Incidence

One random tiller from each of the ten hills in each field was assessed for the neck blast (figure 4) and expressed as per cent. Neck blast incidence was calculated using the following formula:

Neck Blast Incidence (%) =

$$\frac{\text{No. of panicles with severe neck blast x100}}{\text{Total no. of panicles observed per location}}$$

Neck Blast Intensity

The extent of neck blast was further quantified by scoring it using the following scale (Table 2). Neck blast intensity was calculated using the following formula:

Neck Blast Intensity (NBI)(%) =

$$\frac{\Sigma nV \times 100}{N \times \text{maximum grade value}}$$

Where

V = Disease score
n = Number of panicles showing a particular score
N = Total number of panicles examined

Panicle blast

Panicle blast causes direct yield losses, since filling of the grains on infected panicles is poor at best in figure 5. For this reason, and because panicle blast occurs late in the season when the farmer has invested all of his production inputs for the crop, panicle blast is the more serious phase of the blast disease (10). The previous studies to estimate yield loss due to panicle blast have shown that panicle blast incidence may be linearly related to yield loss, using simple empirical damage functions. Comparison of the various studies show that the estimated yield loss ranged from 0.4 to 1.0% per percent infected panicles (11).

Statistical analyses

Data from both trials were subjected to an analysis of variance (ANOVA) to determine the significance of incidence and intensity by the SPSS. The experimental repeats were analysed separately. The least significant difference (LSD) was performed for the mean comparison when varietal differences were found to be significant. We have used F-test for analysis the above rice blast disease that is based f-distribution and used to compare the variance of the two independent samples. This is also used in the context of analysis of variance (ANOVA) for judging the significance of more than two sample means at one and the same time. It is also used for judging the significance of multiple correlation coefficients (Ume 9 • Issue 3 • 1000135).

Results and Discussion

An intensive stratified surveillance of paddy growing in Guru Kashi University farm, five rice varieties *viz.*, PR114, PR 124, PR 126,PR 122, PB 1121 cultivars revealed that the disease occurred in proportions during all the cropping seasons with maximum leaf blast incidence recorded in cultivar PR 114 is 80.0% and minimum in PR 124 is 21.0%, respectively. In Table 3 and Figure, the results revealed that the overall mean leaf blast incidence in all the five rice cultivars during 2017- 2018 varied 38.2 % and 36.2 %, respectively. the highest mean Neck blast incidence in PR 124 is 19.0% and minimum in PR 126 is 14.0%.whereas the pooled neck blast incidence during 2017and 2018 was 18.4% and 15.2%, respectively. The average panicle blast incidence is maximum in PB1121 and minimum in PR 122 is 52.5 and

35.5, respectively. the pooled mean of panicle blast in both year is ranged from36.3 and 37,0 respectively (Table 3). The overall rice blast symptoms in five cultivars most susceptible is PR114 and moderately resistant PB1121.

From table 4, the disease incidence affected mean Rice Blast Scores, F (2, 12) = 3.38, p=.07 at using alpha=0.5. Our hypothesis is that the Rice blast mean is equal to disease intensity. P ("sig")=0.12 for 2017 and P ("sig")=0.07 for 2018, both way are greater than 0.05 so we have accepted these hypotheses. The different disease incidence account for 36% of the variance in the rice blast score. This is the effect size as indicated by partial Eta squared.

Table.1 Leaf blast score description (9)

Disease rating	Description	Host Behaviour
0	No lesion observed	Highly Resistant
1	Small brown specks of pin point size	Resistant
2	Small roundish to slightly elongated, necrotic gray spots, about 1-2 mm in diameter, with a distinct brown margin. Lesions are mostly found on the lower leaves	Moderately Resistant
3	Lesion type same as in 2, but significant number of lesions on the upper leaves	Moderately Resistant
4	Typical susceptible blast lesions, 3 mm or longer infecting less than 4 per cent of leaf area	Moderately Susceptible
5	Typical susceptible blast lesions of 3 mm or longer infecting 4-10 per cent of the leaf area	Moderately Susceptible
6	Typical susceptible blast lesions of 3 mm or longer infecting 11-25 per cent of the leaf area	Susceptible
7	Typical susceptible blast lesions of 3 mm or longer infecting 26-50 per cent of the leaf area	Susceptible
8	Typical susceptible blast lesions of 3 mm or longer infecting 51-75 per cent of the leaf area and many leaves are dead	Highly Susceptible
9	Typical susceptible blast lesions infecting >75 per cent of the leaf area and many leaves dead	Highly Susceptible

Table.2 Neck Blast Score description (9)

Disease rating	Description
0	No visible lesions or lesions only on few pedicles
1	Lesions on several pedicles or secondary branches
3	Lesions on few primary branches or the middle part of panicle axis
5	Lesions partially around the panicle base(node) or the uppermost internode neck of the panicle or the lower part of the panicle axis near the base
7	Lesions completely around the panicle base or the uppermost internode or panicle axis near the base with more than 30% of filled grain
9	Lesions completely around the panicle base or the uppermost internode or panicle axis near the base with less than 30% of filled grain

Table.3 Incidence of leaf and neck blast disease of rice in various cultivars during 2017-2018

Rice cultivars	Leaf blast incidence (%)*		Mean	Neck blast incidence (%)**		Mean	Panicle blast incidence (%)		Mean
	2017	2018		2017	2018		2017	2018	
PR 114	81	79	80.0	22	15	18.5	25.5	26	38.5
PR 124	22	21	21.0	20	18	19.0	47	45	46.0
PR 126	40	38	39.0	15	13	14.0	40	41	40.5
PR 122	25	23	24.0	17	14	15.5	35	36	35.5
PB 1121	23	20	21.5	18	16	17.5	34	37	52.5
Over all mean	38.2	36.2		18.4	15.2		36.3	37.0	

*Average of 100 leaves taken per observation
**Average of 100 panicles taken per observation

Table.4 Tests of disease incidence of Rice Blast using ANOVA

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F-ratio	Sig.	Eta Squared	Noncent. Parameter	Observed Power
Corrected Model	2017	1193.43	2	596.72	2.57	0.12	0.30	5.14	0.42
	2018	1528.13	2	764.07	3.38	0.07	0.36	6.75	0.52
Intercept	2017	14384.02	1	14384.02	62.00	0.00	0.84	62.00	1.00
	2018	13024.27	1	13024.27	57.55	0.00	0.83	57.55	1.00
DISEASE	**2017**	**1193.43**	**2**	**596.72**	**2.57**	**0.12**	0.30	5.14	0.42
	2018	**1528.13**	**2**	**764.07**	**3.38**	**0.07**	**0.36**	6.75	0.52
Error	2017	2783.80	12	231.98					
	2018	**2715.60**	**12**	**226.30**					
Total	2017	18361.25	15						
	2018	17268.00	15						
Corrected Total	2017	3977.23	14						
	2018	4243.733	14						
a Computed using alpha = .05									
b R Squared = .300 (Adjusted R Squared = .183)									
c R Squared = .360 (Adjusted R Squared = .253)									

Table.5 Multiple Comparisons using LSD

Dependent Variable	Incidence (I) and (J)		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
2017	LBI	NBI	19.800	9.633	0.062	-1.188	40.788
		PBI	1.900	9.633	0.847	-19.088	22.888
	NBI	LBI	-19.800	9.633	0.062	-40.788	1.188
		PBI	-17.900	9.633	0.088	-38.888	3.088
	PBI	LBI	-1.900	9.633	0.847	-22.888	19.088
		NBI	17.900	9.633	0.088	-3.088	38.888
2018	LBI	NBI	21.000	9.514	0.048	0.270	41.730
		PBI	-0.800	9.514	0.934	-21.530	19.930
	NBI	LBI	-21.000	9.514	0.048	-41.730	-0.270
		PBI	-21.800	9.514	0.041	-42.530	-1.070
	PBI	LBI	0.800	9.514	0.934	-19.930	21.530
		NBI	21.800	9.514	0.041	1.070	42.530
Based on observed means. The error term is Error.							
***The mean difference is significant at the .05 level.**							

Table.6 Intensity of leaf and neck blast and panicle in rice cultivar during 2017-18

Rice cultivar	Leaf blast intensity (%)*		Mean	Neck blast intensity (%)**		Mean	Panicle blast intensity (%)		Mean
	2017	2018		2017	2018		2017	2018	
PR 114	11	19	15	2	1.5	1.75	3	4	3.5
PR 124	12	11	11	3	1.8	2.4	4	3.4	3.7
PR 126	10	13	11.5	5	1.3	3.15	3.5	4	3.75
PR 122	15	12	13.5	3.7	4	3.85	2.5	3	2.75
PB 1121	13	11	12	2.8	2.6	2.7	2	2.7	2.35
Over all mean	**12.2**	**13**	**12.6**	**3.3**	**2.24**	**2.77**	**3**	**3.42**	**3.21**

*Figures based on observations on 300 leaves
**Figures based on observations on 100 panicles

Table.7 Tests of between-subjects effects of intensity

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power
Corrected Model	2017	273.233	2	136.617	73.253	0.000	0.924	146.506	1.000
	2018	361.937	2	180.969	42.564	0.000	0.876	85.128	1.000
Intercept	2017	570.417	1	570.417	305.853	0.000	0.962	305.853	1.000
	2018	592.833	1	592.833	139.435	0.000	0.921	139.435	1.000
INTENSITY	**2017**	**273.233**	**2**	**136.617**	**73.253**	**0.000**	0.924	146.506	1.000
	2018	**361.937**	**2**	**180.969**	**42.564**	**0.000**	0.876	85.128	1.000
Error	**2017**	**22.380**	**12**	**1.865**					
	2018	**51.020**	**12**	**4.252**					
Total	2017	866.030	15						
	2018	1005.790	15						
Corrected Total	2017	295.613	14						
	2018	412.957	14						
a Computed using alpha = .05									
b R Squared = .924 (Adjusted R Squared = .912)									
c R Squared = .876 (Adjusted R Squared = .856)									

Table.8 Multiple comparisons of disease intensity in rice blast

Dependent Variable	INTENSITY (I) AND (J)		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
2017	LBI	NBI	8.900	0.864	0.000	7.018	10.782
		PBI	9.200	0.864	0.000	7.318	11.082
	NBI	LBI	-8.900	0.864	0.000	-10.782	-7.018
		PBI	0.300	0.864	0.734	-1.582	2.182
	PBI	LBI	-9.200	0.864	0.000	-11.082	-7.318
		NBI	-0.300	0.864	**0.734**	-2.182	1.582
2018	LBI	NBI	10.960	1.304	0.000	8.119	13.801
		PBI	9.780	1.304	0.000	6.939	12.621
	NBI	LBI	-10.960	1.304	0.000	-13.801	-8.119
		PBI	-1.180	1.304	**0.383**	-4.021	1.661
	PBI	LBI	-9.780	1.304	0.000	-12.621	-6.939
		NBI	1.180	1.304	0.383	-1.661	4.021
***Based on observed means. The error term is Error.**							

Fig.1 Grading of Rice Blast (0-9) as per IRRI, 1996

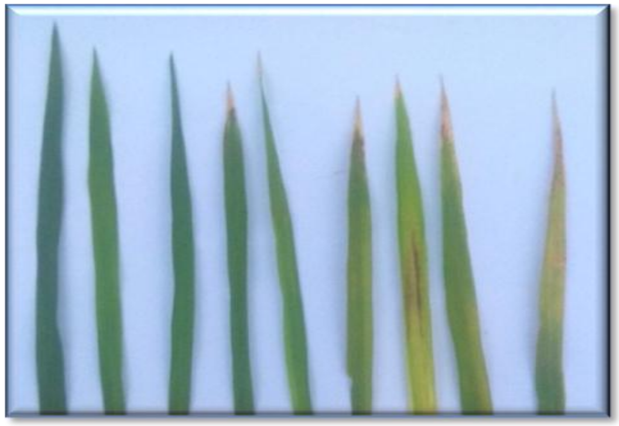


Fig.2 Latin Square Design (LSD) used in field with various rice cultivars

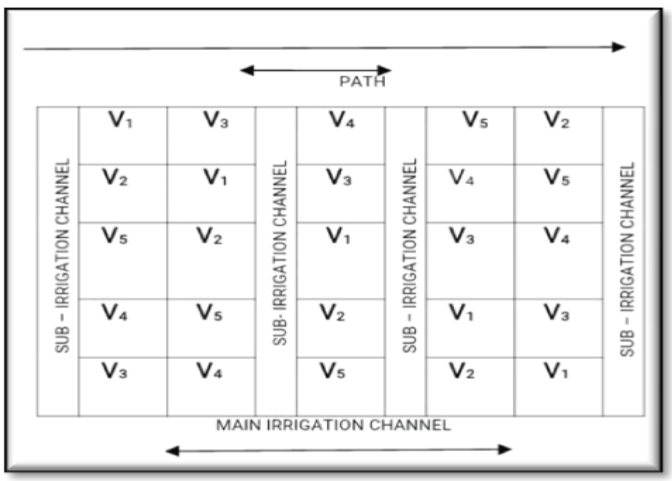


Fig.3 Leaf blast on the upper leaf surface and field of rice

Fig.4 Neck blast on the lower surface neck and field of rice

Fig.5 Symtoms of panicle blast on the panicle rice

Fig.6 Incidence of leaf and neck blast disease of rice in various cultivar during 2017-2018

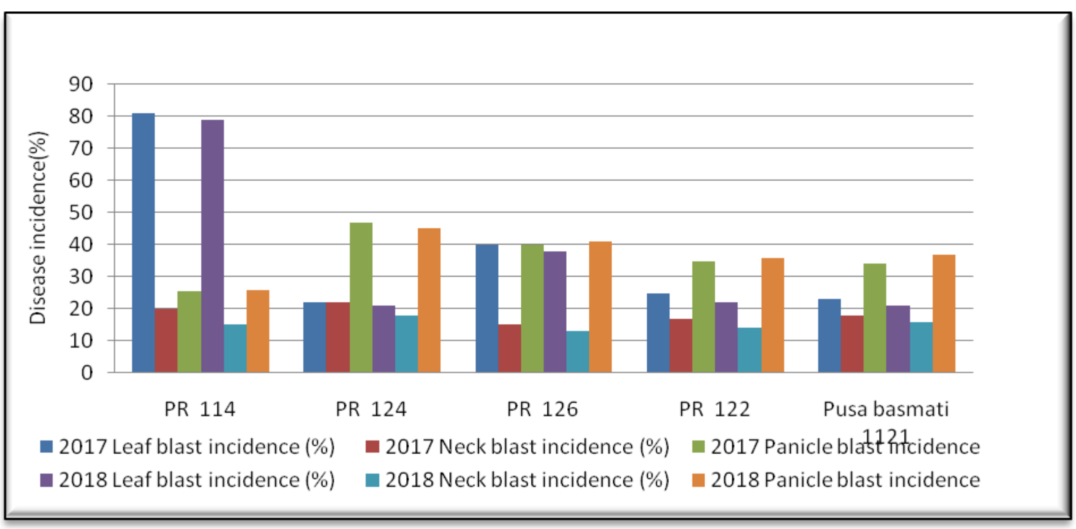
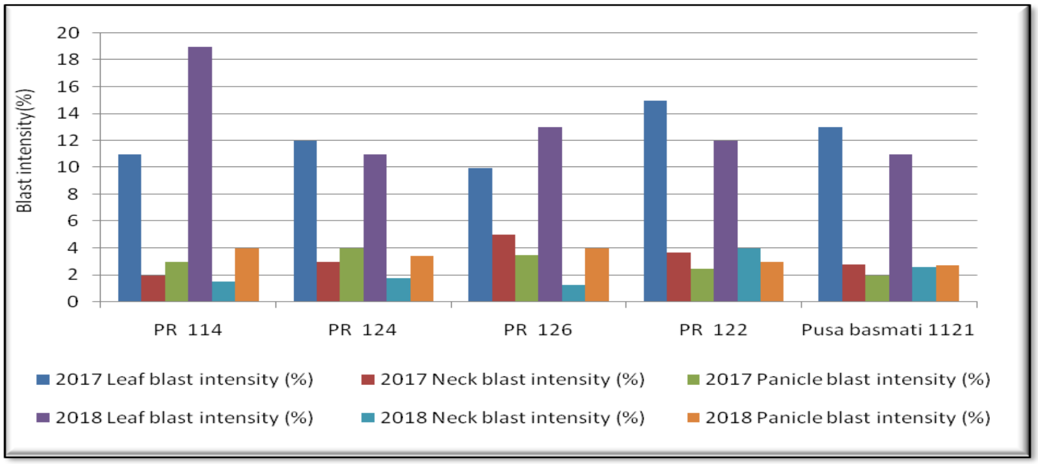


Fig.7 Intensity of leaf and neck blast and panicle in rice cultivar during 2017-18



The table 5 shows that PBI with NBI is significantly rejected because here P < 0.05 from data of rice blast 2018 and NBI with LBI is significantly accepted because her P > 0.05 from data of rice blast data 2017.

In Table 6 and Figure 4, the highest leaf blast intensity 15% was observed PR114 followed by PR124 (11%) during 2017and 2018. The pooled leaf blast intensity during the years 2017 and 2018 was 12.2%, and 13.0% respectively, with a pooled mean of 20.03%. The average neck blast intensity ranged from 3.3% to 2.24% during 2017 and 2018. The highest neck blast intensity was 4.00% recorded in PR124 and 1.3% in PR 126. The highest panicle blast intensity (3.75%) was observed in PR 126 whereas the lowest neck blast incidence (2.35%) was recorded in PB 1121. The pooled panicle blast incidence during 2017 and 2018 was 3.42 and 3.21 per cent, respectively.

From table 7, the disease intensity affected mean Rice Blast Scores, F (2, 12) = 42.564, p=.00 at using alpha=0.5. Our hypothesis is that the Rice blast mean is equal to disease intensity. P (“sig”) = 0.00 for 2017 and P (“sig”) = 0.00 for 2018, both way are less than 0.05 so we have reject these hypotheses. The different disease intensity account for 87.6% of the variance in the rice blast score. This is the effect size as indicated by partial Eta squared.

The table 8 shows that PBI with NBI is significantly accepted because here P>0.05 from data of rice blast 2018 and NBI with LBI is significantly rejected because her P<0.05 from data of rice blast data 2017.

In conclusion this paper, authors have identified the rice blast caused by *Pyricularia oryzae* using five rice cultivars growing in Malwa region of Punjab and study the incidence and intensity of leaf, neck and panicle parts of rice. The surveillance was carried on tillering and around flowering stages. The highest neck blast intensity was 4.83% recorded, whereas the lowest was 1.3% observed. The highest leaf and neck blast incidence of 81.02% and 19.36 % was observed in cultivar PR114, whereas it was the lowest (18.33% and 1.03%) in cultivar Pusa1121. The rice blast shows the occurrence for the disease having the ideal predisposing conditions. The different disease incidence account for 36% of the variance in the rice blast score. The different disease intensity account for 87.6% of the variance in the rice blast score. Moreover, the future research direction should be against rice blast disease with high incidence and intensity (i.e leaf blast, neck blast and panicle blast). Research on this regard should be considered to increase the quantitative and qualitative production of rice.

References

1.Khush, G.S. And Brar, D.S., (2002). Biotechnology for rice breeding: progress and potential impact. In: proceeding of the 20th session of the international rice commission (23th - 26th July, 2002, Bangkok, Thailand)

2.Jia, Y., Me Adams, S.A., Bryan, G.T., Hershay, H.P. and B. Valent (2000). Direct interaction of resistance genes products confers rice blast resistance. Embo. J. 19: 4004 - 4014.

3.Padmanabhan SY, Chakrabarti NK, Mathur SC, Veeraraghavan S (1970) Identification of pathogenic races of *Pyricularia oryzae* in India. Phytopathology 60: 1574-1577.

4.Ramesh Singh Yadav and Amit Kumar Yadav. (2018). Development of Blast Disease Management Modules for Minimization of Tricycazole in Basmati Rice. *Int.J.Curr.Microbiol.App.Sci.* 7(10): 777-781

5.Kapadiya IB, Akbari LF, Siddhapara MR, Undhad SV (2013) Evaluation of fungicides and herbicides against the sheath blight of rice. The Bioscan 8: 433-436

6.Dodan, D.S. and Ram Singh (1995). Effect of planting time on the incidence of blast and false smut of rice in Haryana. Indian Phytopathol. 48: 185-186

7.Chowdhury MD, Riton K, Vinodsattar A, Brahmachari K (2014) Studies on the water use efficiency and nutrient uptake by rice under system of intensification. The Bioscan 9: 85-88.

8.Mackill DJ, Bonman JM (1992) Inheritance of blast resistance in near isogenic lines of rice. Phytopathology 82: 746-749.

9.Goto I (1965a) Plant insect and disease survey. Special Report 18: 132.

10.Ziegler R S, Leong S A, Teng P S (Eds.) Rice blast disease. CAB International, Wallingford Oxon OX10 8DE, UK.

11.Ou SH, Ayad MR (1970) Pathogenic races of pyricularia oryzae originating from single lesions and monoconidial cultures. Phytopathology 58: 179-182.

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