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SURVEY ON RICE BLAST DISEASE INCIDENCE IN MAJOR RICE GROWING AREAS OF BANGLADESH

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ABSTRACT

Rice blast (*Pyricularia oryzae* Cavara) is one of the most devastating diseases that cause severe yield losses every year in Bangladesh. Eight rice-growing districts of Bangladesh, namely Dinajpur, Rangpur, Bogura, Natore, Meherpur, Rajbari, Mymensingh, and Jashore, were surveyed to estimate the incidence and severity of leaf and neck blast diseases of rice at vegetative and reproductive stages. The highest leaf and neck blast incidence of 28 and 11% was observed in Dinajpur, whereas it was the lowest in Rajbari and Jashore. The leaf blast severity ranged from 28% in Dinajpur to 2% in Rajbari and Jashore. The highest neck blast severity was recorded in Dinajpur, whereas the lowest was observed at Rajbari and Jashore. The study revealed that rice blast disease (leaf and neck blast diseases) is more prevalent in the northern regions of Bangladesh acts as a hot spot for the disease having the ideal predisposing conditions compared to southern regions.

1. INTRODUCTION

Rice (*Oryza sativa* L.) is a major staple food crop for half of the world's population. It provides 21% of global human per capita energy and 15% per capita protein (Akter *et al.*, 2019). Rice is also the primary staple food and the most important crop to millions of farmers in Bangladesh. The rice sector contributes one-half of the agricultural GDP and one-sixth of the national income in Bangladesh. Over 28 million acres of land in Bangladesh are dedicated to rice production, which annually provides more than 35 million tons of rice (BBS 2017). Rice yield stands to an average of 3.35 tons per hectare. The population of Bangladesh is still growing by two million every year, while the total rice area is gradually shrinking. Rice yield, therefore, needs to be increased. Diseases are one of the

main limiting factors for rice production. Rice can be infected by 31 diseases. Farmers lose an estimated average of 18% of rice crops to diseases every year (Willocquet *et al.*, 1998). The epidemic occurrence of rice diseases occasionally may cause as high as 100% yield losses. A crop failure in one cropping season by any disease poses a real threat of starvation and brings untold suffering to the common people. Therefore, effective management of rice diseases may offer a very lucrative opportunity to produce additional rice even by using the available technologies.

The pathogen is most common on leaves, causing leaf blast during the vegetative stage or on nodes, neck, and panicle branches during the reproductive stage, causing node and neck blast, respectively (Bonman, 1992). Leaf blast lesions reduce the net photosynthetic rate of individual leaves to an extent far beyond the visible diseased leaf fraction (Bastiaans, 1991). Neck blast is considered the most destructive phase of the disease and can occur without being preceded by severe leaf blast (Zhu *et al.*, 2005). Yield reduction by neck blast infection is twice as severe as leaf blast (Hwang *et al.*,1987). Neck blast causes direct yield losses, since filling of the grains on infected panicles is poor at best (Goto, 1965).

Among the rice diseases, blast caused by *Pyricularia oryzae* is the most explosive and potentially damaging disease. The disease affects the crop at all stages. The average loss due to blast has been reported to be around 28-36%, and in certain areas yield losses could be as high as 80-100% (Kato, 2001; Hossain *et al.*, 2017). So it is the potential threat for crop failure from this disease that it has been ranked among the most important plant diseases of them all. Although rice blast has worldwide distribution, the humid tropical environments in Bangladesh are highly conducive to blast infection. The recent widespread occurrence of rice blast disease across the country poses a major challenge to the food security as most of the rice varieties grown are susceptible to this disease. Therefore, it is necessary to determine the regional and seasonal distribution of rice blast diseases occurring in the country every year to design proper management packages to safeguard rice production against the potential threat of *P. oryzae* in Bangladesh. With the view of above facts, the study was undertaken to determine the leaf and neck blast disease incidence and severity of rice (*Oryza sativa* L.) in some important selected areas of Bangladesh.

2. MATERIALS AND METHODS

2.1 Study area and study period

A survey was conducted in eight rice growing districts of Bangladesh, namely Dinajpur, Rangpur, Bogura, Natore, Meherpur, Rajbari, Mymensingh, and Jashore (Fig.1). The rice blast disease survey was conducted in farmers' fields during the Boro season of 2017 to 2019 (November to May in each year; irrigated ecosystem).

2.2 Survey method

Three random rice-growing upazilas in each district and three fields representing each upazila were selected to record the incidence and severity of rice blast at vegetative and reproductive stages. The leaf blast incidence was recorded by assessing the upper three leaves of each random tiller from each of the ten random hills from each field and expressed as percent for each location (Chowdhury *et al.*, 2014).

$$\text{Disease incidence (\%)} = \frac{\text{Number of diseased leaves}}{\text{Total number of leaves assessed}} \times 100$$

The following 0 to 9 scale (Goto and Yamanaka, 1968; Mackill and Bonman,1992; Hayashi

and Fukuta, 2009a; Khan *et al.*, 2016) was adopted for recording the blast severity of leaves in each field (Figure 2, Table 1).

The leaf blast disease severity was calculated using the following formula: -

$$\text{Percent leaf blast severity (PDS)} = \frac{\sum nv}{N \times \text{Maximum grade value}} \times 100$$

Where,

PDS = Per cent disease severity

$\sum$ = Summation

V = Disease score

n = Number of leaves showing a particular score

N = Total number of leaves examined/assessed

2.3 Neck blast incidence

One random tiller from each of the ten hills in each field was assessed for the neck blast and expressed as per cent.

Neck blast incidence was calculated using the following formula: -

$$\text{Neck blast incidence (\%)} = \frac{\text{Number of panicles with severe neck blast}}{\text{Total number of panicles observed per location}} \times 100$$

2.4 Neck blast severity

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

Neck blast severity was calculated using the following formula: -

$$\text{Percent neck blast severity (NBS)} = \frac{\sum nv}{N \times \text{Maximum grade value}} \times 100$$

Where,

NBS = Percent neck blast severity

$\sum$ = Summation

V = Disease score

n = Number of panicles showing a particular score

N = Total number of panicles examined

2.5 Data analysis

The data were analyzed by using the "R" Software (R Core Team, 2018). The mean value was compared according to LSD range test at 5% level of significance.

3. RESULTS AND DISCUSSION

An intensive survey of major eight rice-growing districts such as Dinajpur, Rangpur, Bogura, Natore, Meherpur, Rajbari, Mymensingh, and Jashore of Bangladesh, revealed that the disease occurred in all the surveyed area of Bangladesh in varying degrees during boro cropping seasons. The maximum leaf and neck blast incidence recorded in Dinajpur 19.33% and 11.33% in the year of 2017 and 2019, respectively, Whereas the Rangpur was 18% and 10.33%, respectively in 2019 (Table 3). The highest

leaf blast incidence (22%) was recorded in Birganj, Dinajpur and the lowest (3%) was recorded from Manirampur, Jashore whereas the highest (12.40%) neck blast incidence was observed in Dinajpur Sadar in 2019 and the lowest (0.80%) was observed in Jhikargachha, Jessore in 2017. The results indicated the overall mean leaf blast incidence in all eight districts during 2017, 2018, and 2019 varied from 17.22 % in Dinajpur to 7% in Jashore (Table 3). The highest mean leaf blast incidence of 19.33 % was observed in Dinajpur followed by 18 % in Rangpur, whereas it was the lowest 5% in Jashore during 2017-2019. The pooled leaf blast incidence during 2017, 2018, and 2019 was 13.33%, 8.38%, and 14.08%, respectively, with a pooled mean of 11.93%. The pooled neck blast incidence during 2017, 2018, and 2019 was 3.62%, 4.71%, and 5.84%, respectively, with a pooled mean of 4.73% (Table 3).

The average leaf blast severity ranged from 19% in Dinajpur to 6.33% in Rajbari (Table 4) during 2017, 2018 and 2019. The highest leaf blast severity 28% was observed at Birganj followed by 26%, 25% in Dinajpur and 23%, 20% in Natore during 2017, 2018 and 2019. The pooled leaf blast severity during the years 2017, 2018 and 2019 was 13.04%, 9.21%and 14.04%, respectively, with a pooled mean of 12.10%. The average neck blast severity ranged from 7.44 % in Dinajpur to 1.89% in Rajbari during 2017, 2018 and 2019. The highest neck blast severity 11% was recorded at kaharole in Dinajpur, whereas the lowest neck blast severity 1% was observed at Rajbari sadar in Rajbari. The pooled neck blast severity during the years 2017, 2018 and 2019 was 5%, 5% and 4.08 %, respectively, with a pooled mean of 4.69% (Table 4).

The prevalent occurrence of the disease and the initiation and development of different rice genotypes and their distribution in time and space prejudice the pathogen population for co-evolution and the emergence of variable isolates and pathotypes/races. Determining the prevalence, regularity of occurrence and the ultimate status of the disease in length and breadth of rice growing areas was, therefore, imperative before taking up studies on pathogen variability. The disease has been found to occur with different dimensions in other parts of the globe. Several studies have been made to assess the incidence and severity of leaf and neck blast (Anwar *et al.*, 2009; Padmanabhan *et al.*, 1970; Goto, 1965a; Ou and Ayad, 1970; Tseng *et al.*,1964). Dissimilarities in disease severity observed in different years and different places during the present studies were mostly due to deviations in fertilizer dosage, field and seed insanitation and the tolerance levels of rice genotypes cultivated. The rice-growing regions that revealed higher blast severity levels were the hot spots of the disease where the prejudicing factors for the disease development and spread were prevalent. High plant density with high relative humidity in the micro-environment and high inoculum load in fields/areas with history of blast occurrence performs as the major factors for the pathogen explosion and establishing of infection in the surveyed areas.

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Conflict of interests

The authors declare no conflict of interest among them.

REFERENCES

1. Akter, T., Parvin, M.T., Mila, F.A., & Nahar, A. (2019). Factors determining the profitability of rice farming in Bangladesh, *Journal of the Bangladesh Agricultural University, 17(1),* 86-91.
2. Anwar, A., Teli, M.A., Bhat, G.N., Parray, G.A., & Wani, S. (2009). Status of rice blast (*Pyricularia grisea*), cultivar reaction and races of its causal fungus in temperate agro-ecosystem of kashmir, India, *SAARC Journal of Agriculture, 7*, 25-37.
3. Bangladesh Bureau of Statistics (BBS), (2017). Bangladesh Population and Housing Census 2011, Statistics and Informatics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.
4. Bastiaans, L. (1991). Ratio between virtual and visual lesion size as a measure to describe reduction in leaf photosynthesis of rice due to leaf blast, *Phytopathology, 81*, 611–615.
5. Bonman, J.M. (1992). Blast, in: Webster, R.K., Gunnell, P.S. (Eds.), Compendium of Rice Diseases, American Phytopathological Society Press, Saint Paul, MN, USA, pp.14-17.
6. Chowdhury, M.D., 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.
7. Goto, I. (1965a). Plant insect and disease survey. Special Report, 18:132.
8. Goto, K. (1965). Estimating losses from rice blast in Japan, in: The Rice Blast Disease, Johns Hopkins Press, Baltimore, MD, USA, pp.195-202.
9. Goto, K., & Yamanaka, S. (1968). Studies on the race of blast fungus. Bulletin of the Faculty of Agriculture, Utsunomiya University, 7(2): 27-71.
10. Hayashi, N., & Fukuta, Y. (2009). Proposal for a new international system of differentiating races of blast (*Pyricularia oryzae* Cavara) by using LTH monogenic lines in rice (*Oryza sativa* L.) in: JIRCAS Working Report No. 63. Japan International Research Center for Agricultural Sciences, Tsukuba, Ibaraki, Japan, pp11-15.
11. Hossain, M., Ali, M. A., & Hossain, M. D. (2017). Occurrence of blast disease in rice in Bangladesh. *American Journal of Agricultural Science, 4 (4)*, 74-80.
12. Hwang, B.K., Koh, Y. J., & Chung, H. S. (1987). Effects of adult-plant resistance on blast severity and yield of rice, *Plant Disease, 71*,1035-1038.
13. Kato, H.2001. Rice blast disease. Pesticide outlook, 12(1): 23-25.
14. Khan, M.A.I., Ali, M.A., Monsur, M.A., Kawasaki-Tanaka, A., Hayashi, N., Yanagihara, S., Obara, M., Mia, M.A.T., Latif, M.A., & Y. Fukuta. 2016. Diversity and Distribution of Rice Blast (*Pyricularia oryzae* Cavara) Races in Bangladesh, *Plant Disease, 100(10),* 2025-2033.
15. Mackill, D.J., & Bonman, J.M. (1992). Inheritance of blast resistance in near-isogenic lines of rice, *Phytopathology, 82,* 746-749.
16. Ou, S.H., & Ayad, M.R. (1970). Pathogenic races of *Pyricularia oryzae* originating from single lesions and monoconidial cultures, *Phytopathology, 58*,179-182.

17. Padmanabhan, S.Y., Chakrabarti, N.K., Mathur, S.C., and Veeraraghavan, S. (1970). Identification of pathogenic races of *Pyricularia oryzae* in india, *Phytopathology, 60*,1574-1577.
18. R Core Team. (2018). A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.URL https://www.R-project.org/.
19. Tseng, T.C., Yuan, C.S., & Wu, L.C. (1964). Temperature response of *Pyricularia oryzae* cav. isolated in different seasons in Taiwan, *Botanical Bulletin of Academy of Sciences*, *6*, 93-100.
20. Willocquet, L., Savary, 5., Fernandel, L., Elazegui, F., & Teng, P. (1998). Simulation of yield losses caused by rice diseases, insècts, and weeds in tropical Asia IRRI Discussion Paper Series No. 34. Manila (Philippines): International Rice Research Institute, 62p.
21. Zhu, Y.Y., Fang, H., Wang, Y.Y., Fan, J.X., Yang, S.S., Mew, T.M., & Undt, C.C. (2005). Panicle blast and canopy moisture in rice cultivar mixtures, *Phytopathology, 95*, 433-438.

TABLES

Table 1: Leaf blast disease score for rice (Goto and Yamanaka, 1968; Mackill and Bonman, 1992; Hayashi and Fukuta 2009; Khan *et al.*, 2016)

Leaf blast score	Score description
0	No evidence of infection
1	Brown specks smaller than 0.5 mm in diameter, No sporulation. Uniform or scattered brown specks, no sporulation
2	Brown specks about 0.5-1.00 mm in diameter, no sporulation. Small lesions with distinct tan centres surrounded by a darker brown margin approximately 1 mm in diameter, No sporulation
3	Roundish to elliptical lesion about 1-3 mm in diameter with gray centre surrounded by brown margins, lesions capable of sporulation. Small eyespot lesions less than one and a half times the interval between thin veins or less than 1.5 mm in diameter surrounded by dark brown, lesions capable of sporulation
4	Typical spindle-shaped blast lesion capable of sporulation, 3 mm or longer with necrotic gray centres, and water-soaked brown margins little or no coalescence of the lesion. Intermediate-size eyespot lesions are less than twice the interval between thin veins or less than 2 mm in diameter
5	Lesions as in 4 but about half of one or two leaf blades killed by coalescence of the lesion. Large eyespot lesions more than twice the interval between thin veins or more than 2 mm in diameter

Table 2: Neck blast disease score for rice (Goto and Yamanaka, 1968; Mackill and Bonman, 1992; Hayashi and Fukuta, 2009; Khan *et al*., 2016).

Neck blast score	Score description
0	No visible lesions or lesions only on few pedicles
1	lesions on several pedicels or secondary branches
3	lesions on a few primary branches or the middle part of panicle axis
5	lesions partially around the base (node) or the uppermost internodes or the lower part of the panicle axis near the base
7	lesion completely around the panicle base or uppermost internodes or panicle axis near the base with more than 30% of filled grains
9	lesion completely around the panicle base or uppermost internodes or the panicle axis near the base with less than 30% of filled grains

Table 3: Incidence of leaf and neck blast (*Pyricularia oryzae*) disease of rice at different districts in Bangladesh during boro season of 2017-2019

District	Upazila	Leaf blast disease incidence (%)				Neck blast disease incidence (%)			
		2017	2018	2019	Mean	2017	2018	2019	Mean
Dinajpur	Birganj	22.00	14.00	17.00	17.67	7.10	8.20	10.40	8.57
	kaharole	19.00	15.00	20.00	18.00	7.80	9.40	11.20	9.47
	Sadar	17.00	13.00	18.00	16.00	8.20	10.10	12.40	10.23
Mean		19.33	14.00	18.33	17.22	7.70	9.23	11.33	9.42
Rangpur	Taraganj	13.00	6.00	12.00	10.33	7.80	9.20	10.30	9.10
	Badarganj	15.00	12.00	21.00	16.00	8.10	9.50	11.20	9.60
	Kaunia	18.00	8.00	21.00	15.67	6.20	7.40	9.50	7.70
Mean		15.33	8.67	18.00	14.00	7.37	8.70	10.33	8.80
Bogura	Shibganj	21.00	11.00	19.00	17.00	2.60	3.20	4.30	3.37
	Sadar	11.00	6.00	17.00	11.33	3.20	3.70	4.20	3.70
	Adamdighi	9.00	6.00	11.00	8.67	6.70	7.30	8.40	7.47
Mean		13.67	7.67	15.67	12.33	4.17	4.73	5.63	4.84
Natore	Sadar	16.00	12.00	18.00	15.33	1.25	1.72	2.31	1.76
	Singra	12.00	6.00	9.00	9.00	1.80	2.82	3.30	2.64
	Baraigram	10.00	5.00	9.00	8.00	2.10	2.50	3.10	2.57
Mean		12.67	7.67	12.00	10.78	1.72	2.35	2.90	2.32
Meherpur	Sadar	18.00	12.00	15.00	15.00	1.50	1.70	1.85	1.68
	Mujibnagar	15.00	11.00	16.00	14.00	1.42	1.68	1.90	1.67
	Gangni	12.00	9.00	13.00	11.33	2.40	6.90	7.20	5.50
Mean		15.00	10.67	14.67	13.44	1.77	3.43	3.65	2.95
Rajbari	Pangsha	9.00	4.00	11.00	8.00	2.80	5.80	8.10	5.57
	Sadar	11.00	9.00	14.00	11.33	3.20	4.60	7.40	5.07
	Kalukhali	13.00	7.00	15.00	11.67	4.10	5.60	6.80	5.50
Mean		11.00	6.67	13.33	10.33	3.37	5.33	7.43	5.38
Mymensingh	Sadar	15.00	8.00	14.00	12.33	1.10	1.40	1.90	1.47
	Ishwarganj	8.00	5.00	13.00	8.67	1.80	2.60	3.10	2.50
	Gauripur	11.00	7.00	12.00	10.00	2.20	2.80	3.90	2.97
Mean		11.33	6.67	13.00	10.33	1.70	2.27	2.97	2.31
Jashore	Jhikargachha	12.00	8.00	14.00	11.33	0.80	1.30	1.90	1.33
	Sadar	8.00	4.00	5.00	5.67	1.30	1.90	2.80	2.00
	Manirampur	5.00	3.00	4.00	4.00	1.50	1.80	2.70	2.00
Mean		8.33	5.00	7.67	7.00	1.20	1.67	2.47	1.78
Pooled mean		13.33	8.38	14.08	11.93	3.62	4.71	5.84	4.73
Level of significance					*				**

*Figures based on 100 leaves per observation

** Figures based on 100 panicles per observation

Table 4: Severity of leaf and neck blast (*Pyricularia oryzae*) disease of rice at different districts in Bangladesh during boro season of 2017-2019.

District	Upazila	Leaf blast disease severity (%)				Neck blast disease severity (%)			
		2017	2018	2019	Mean	2017	2018	2019	Mean
Dinajpur	Birganj	26.00	24.00	28.00	26.00	8.00	6.00	5.00	6.33
	kaharole	24.00	22.00	25.00	23.67	9.00	11.00	10.00	10.00
	Sadar	6.00	5.00	11.00	7.33	6.00	7.00	5.00	6.00
Mean		18.67	17.00	21.33	19.00	7.67	8.00	6.67	7.44
Rangpur	Taraganj	18.00	17.00	20.00	18.33	3.00	2.00	4.00	3.00
	Badarganj	14.00	12.00	15.00	13.67	5.00	4.00	3.00	4.00
	Kaunia	8.00	7.00	9.00	8.00	7.00	8.00	7.00	7.33
Mean		13.33	12.00	14.67	13.33	5.00	4.67	4.67	4.78
Bogura	Shibganj	20.00	10.00	18.00	16.00	9.00	7.00	6.00	7.33
	Sadar	16.00	13.00	18.00	15.67	8.00	6.00	5.00	6.33
	Adamdighi	12.00	10.00	13.00	11.67	5.00	7.00	6.00	6.00
Mean		16.00	11.00	16.33	14.44	7.33	6.67	5.67	6.56
Natore	Sadar	22.00	12.00	20.00	18.00	7.00	9.00	7.00	7.67
	Singra	23.00	13.00	20.00	18.67	6.00	6.00	5.00	5.67
	Baraigram	21.00	17.00	22.00	20.00	4.00	2.00	3.00	3.00
Mean		22.00	14.00	20.67	18.89	5.67	5.67	5.00	5.44
Meherpur	Sadar	10.00	3.00	9.00	7.33	4.00	3.00	2.00	3.00
	Mujibnagar	9.00	6.00	12.00	9.00	3.00	6.00	4.00	4.33
	Gangni	10.00	7.00	11.00	9.33	2.00	2.00	1.00	1.67
Mean		9.67	5.33	10.67	8.56	3.00	3.67	2.33	3.00
Rajbari	Pangsha	8.00	2.00	7.00	5.67	2.00	3.00	2.00	2.33
	Sadar	7.00	4.00	6.00	5.67	1.00	1.00	2.00	1.33
	Kalukhali	8.00	6.00	9.00	7.67	3.00	2.00	1.00	2.00
Mean		7.67	4.00	7.33	6.33	2.00	2.00	1.67	1.89
Mymensingh	Sadar	10.00	6.00	9.00	8.33	9.00	7.00	4.00	6.67
	Ishwarganj	6.00	4.00	13.00	7.67	8.00	9.00	6.00	7.67
	Gauripur	15.00	9.00	14.00	12.67	5.00	4.00	3.00	4.00
Mean		10.33	6.33	12.00	9.56	7.33	6.67	4.33	6.11
Jashore	Jhikargachha	9.00	5.00	8.00	7.33	2.00	2.00	1.00	1.67
	Sadar	7.00	5.00	14.00	8.67	3.00	5.00	4.00	4.00
	Manirampur	4.00	2.00	6.00	4.00	1.00	1.00	2.00	1.33
Mean		6.67	4.00	9.33	6.67	2.00	2.67	2.33	2.33
Pooled mean		13.04	9.21	14.04	12.10	5.00	5.00	4.08	4.69
Level of significance					*				**

*Figures based on 100 leaves per observation

** Figures based on 100 panicles per observation

Figures

Figure 1. Map showing place of collection of leaf & neck blast isolates.

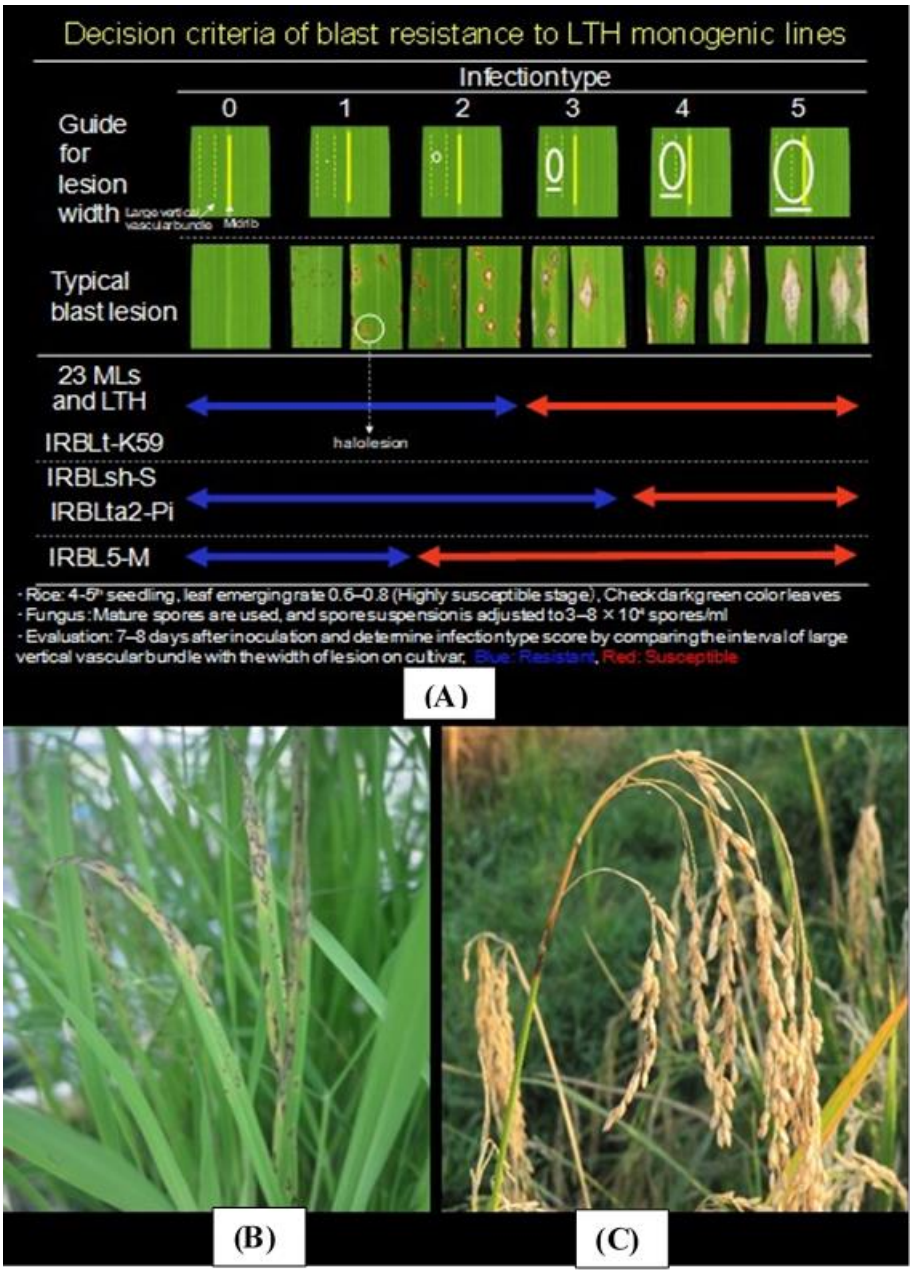

Figure 2. Pictorial view of disease rating scale (0 to 5) of rice leaf blast disease (Hayashi and Fukuta, 2009) (A), leaf blast Diseased plant (B), Neck blast diseased plant(C).