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Research Article

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Survey and Status of Rice Blast Caused by Magnaporthe Oryzae B.C. Couch in Commercial Rice Growing Areas of Kashmir

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Abstract

Four commercial rice growing districts of Kashmir valley *viz.,*Bandipora, Kulgam, Anantnag and Pulwama were surveyed for incidence and intensity of leaf and neck blast of rice. The survey was carried out at tillering and around flowering stages. The highest leaf and neck blast incidence of 80.67 and 19.36 per cent was observed in Anantnag, whereas it was the lowest (18.33 and 1.03 per cent) in Kakapora in district Pulwama. The leaf blast intensity ranged from 10.82 per cent in district Bandipora to 29.59 per cent in district Kulgam. The highest neck blast intensity (4.83%) was recorded at Duroo Shahabad, whereas the lowest (0.77%) was observed at Ajus in district Bandipora. The rice blast showed the highest occurrence in south Kashmir as it is the hot spot for the disease having the ideal predisposing conditions for the disease.

Keywords

Magnaporthe oryzae; Kashmir; Rice blast; Neck blast; Leaf blast; Incidence; Intensity

Introduction

Among the major constraints in boosting the production and productivity of rice in the state, the onslaught of blast disease is believed to be a major bottleneck, and takes a heavy toll of the produce [1]. Rice blast caused by *Magnaporthe oryzae* is endemic to most rice-growing areas of Kashmir valley due to prevailing blast-conducive environments during the crop season [2].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 [3]. Frequent epiphytotics of the disease in the state for the last about fifteen years have been inflicting heavy qualitative and quantitative losses to the growers. The disease emerged as a major problem in the Jammu and Kashmir state prior to 1950's [4]. With the evolution and wide spread cultivation of blast tolerant varieties, the blast incidence in Kashmir remained under check till suddenly the disease surfaced in late 1990's . In order to provide a baseline information on the status of the disease in the major rice growing areas in the valley and its relation with edaphic factors and effect on productivity, the present investigation was taken up to analyse the status of incidence and intensity of rice blast.

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Materials and Methods

Three random rice growing blocks/locations in each district and five fields representing each block/location were selected to record the incidence and intensity of rice blast at, tillering and around flowering stages.

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].

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

The following 0 to 9 scale [6] was adopted for recording the blast intensity of leaves in each field (Figure 1 ; Table 1).

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

$$\text{Per cent leaf blast intensity (PDI)} = \frac{\Sigma nv}{\text{N x maximum grade value}} * 100$$

Where

PDI = Per cent disease intensity

Σ = Summation

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 and expressed as per cent. Neck blast incidence was calculated using the following formula:-

$$\text{Neck blast incidence (\%)} = \frac{\text{No. of panicles with severe neck blast}}{\text{Total No. of panicles observed per location}} * 100$$

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:-

$$\text{Percent neck blast intensity (NBI)} = \frac{\Sigma nv}{\text{N x maximum grade value}} * 100$$

Where

NBI = Per cent neck blast basnity

Σ = Summation

V = Disease score

n = Number of panicles showing a particular score

N = Total number of panicles examined

Figure 1: Grading of infected rice leaves on 0-9 scale.

Results and Discussion

An intensive stratified survey of paddy growing areas of four rice growing districts *viz.,* Anantnag, Bandipora, Kulgam and Pulwama, of Kashmir valley, revealed that the disease occurred in all the surveyed areas of Kashmir in varying proportions during all the cropping seasons with maximum leaf and neck blast intensity recorded in district Anantnag (36.89 and 4.83%, respectively) and Kulgam (29.58 and 3.54%,respectively) known as the rice bowl of Kashmir; the leaf blast intensity in Pulwama and Bandipora being lower (12.18 and 10.82%, respectively). Anwar et al. [1] also confirmed high incidence and intensity of leaf and neck blast in these areas. The results (Table 3) revealed that the overall mean leaf blast incidence in all the four districts during 2011, 2012 and 2013 varied from 21.78 per cent in district Bandipora to 61.45 per cent in district Kulgam. The highest mean leaf blast incidence of 80.67 per cent was observed in Anantnag followed by 74.76 per cent in Duroo Shahabad in district Anantnag, whereas it was the lowest (18.33%) in Kakapora in district Pulwama during 2011-13. The pooled leaf blast incidence during 2011, 2012 and 2013 was 45.50, 31.75 and 48.69 per cent, respectively, with a pooled mean of 41.98 per cent.

The average leaf blast intensity ranged from 10.82 per cent in district Bandipora to 29.59 per cent in district Kulgam (Table 4) during 2011, 2012 and 2013. The highest leaf blast intensity (36.89%) was observed at Anantnag followed by Duroo Shahabad (34.04%) in district Anantnag and Khudwani (33.41%) in district Kulgam during 2011, 2012 and 2013. The pooled leaf blast intensity during the years 2011, 2012 and 2013 was 21.12, 15.30 and 23.67 per cent, respectively, with a pooled mean of 20.03 per cent. The average neck blast intensity ranged from 0.97 per cent in district Bandipora to 4.14 per cent in district Anantnag (Table 4) during 2011, 2012 and 2013. The highest neck blast intensity (4.83%) was recorded at Duroo Shahabad

The average neck blast incidence ranged from 1.83 per cent in district Pulwama to 12.57 per cent in district Anantnag during 2011, 2012 and 2013 (Table 3). The highest neck blast incidence (19.36%) was observed in Anantnag followed by Duroo Shahabad (16.53%) in district Anantnag, whereas the lowest neck blast incidence (1.03%) was recorded in Kakapora in district Pulwama. The pooled neck blast incidence during 2011, 2012 and 2013 was 5.88, 4.32 and 7.68 per cent, respectively, with a pooled mean of 5.96 per cent followed by Anantnag (4.50%) in district Anantnag, whereas the lowest neck blast intensity (0.77 %) was observed at Ajus in district Bandipora. The pooled neck blast intensity during the years 2011, 2012 and 2013 was 2.32, 2.64 and 2.32 per cent, respectively, with a pooled mean of 2.43 per cent.

The widespread occurrence of the disease and the introduction and cultivation of different rice genotypes together with their distribution in time and space predispose the pathogen population for co-evolution and emergence of variable isolates and pathotypes/races. Ascertaining the prevalence, frequency of occurrence and the ultimate status of the disease in length and breadth of rice growing areas of the valley was, therefore, imperative before taking up studies on pathogen variability. The disease has been found occurring with different dimensions in other parts of the globe. Several studies have been made to estimate the incidence and intensity of leaf and neck blast [1,7,8,2,9].Variations in disease intensity observed in different years and different places during the present studies were mostly due to variations in fertilizer dosage, field and seed insanitation and the tolerance levels of rice genotypes cultivated. The rice growing regions which showed higher levels of blast intensity were the hot spots of the disease where the predisposing 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 serve as the main factors for the pathogen proliferation and establishment of infection in the surveyed areas as have also been argued by Rathour et al. [10] and Singh et al. [11].

Table 1: Leaf blast disease score for rice [6].

Leaf blast score	Score description
0	No lesions
1	Small brown specks of pin head size
2	Larger brown specks
3	Small, roundish to slightly elongated, necrotic grey spots about 1-2 mm in diameter, with distinct brown margin
4	Typical blast lesions, elliptical, 1-2 cm long, usually confined to the area of the 2 main veins, infecting less than 2 per cent of the leaf area
5	Typical blast lesions infecting less than 10 per cent of leaf area
6	Typical blast lesions infecting 11-25 per cent of leaf area
7	Typical blast lesions infecting 26-50 per cent of leaf area
8	Typical blast lesions infecting 51-75 per cent of leaf area and many leaves dead
9	All leaves dead

Table 2: Neck blast disease score for rice [6].

Neck Blast Score	*Score 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

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Table 3: Incidence of leaf and neck blast (*Magnaporthe oryzae*) disease of rice at different locations in Kashmir during 2011-2013.

District	Location	Leaf blast incidence (%)*				Neck blast incidence (%)**			
		2011	**2012**	**2013**	**Mean**	**2011**	**2012**	**2013**	**Mean**
Anantnag	Anantnag	81.00	74.00	87.00	80.67	20.00	15.34	22.75	19.36
	Duroo Shahabad	79.00	65.00	80.29	74.76	17.34	12.25	20.00	16.53
	Larnoo	25.00	22.00	35.00	27.33	0.00	0.00	5.42	1.81
Mean		**61.67**	**53.67**	**67.43**	**60.92**	**12.45**	**9.20**	**16.06**	**12.57**
Pulwama	Kakapora	23.00	10.00	22.00	18.33	1.33	0.00	1.75	1.03
	Pampore	25.00	19.00	38.00	27.33	1.33	1.25	6.27	2.95
	Pinglina	28.00	17.00	32.00	25.67	1.42	0.00	3.12	1.51
Mean		**25.33**	**15.33**	**30.67**	**23.78**	**1.36**	**0.42**	**3.71**	**1.83**
Bandipora	Ajus	31.00	14.00	29.00	24.67	1.75	1.25	4.42	2.47
	Bandipora	21.00	12.00	35.00	22.67	1.42	1.25	3.42	2.03
	Potushai	19.00	11.00	24.00	18.00	3.42	0.00	1.75	1.72
Mean		**23.67**	**12.33**	**29.33**	**21.78**	**2.20**	**0.83**	**3.20**	**2.08**
Kulgam	Khudwani	76.00	59.00	83.00	72.67	10.33	9.15	11.25	10.24
	Kulgam	68.00	36.00	55.00	53.00	7.78	6.00	6.27	6.68
	Yaripora	70.00	42.00	64.00	58.67	4.42	5.33	6.33	5.36
Mean		**71.33**	**45.67**	**67.33**	**61.45**	**7.51**	**6.83**	**7.73**	**7.36**
Pooled mean		**45.50**	**31.75**	**48.69**	**41.98**	**5.88**	**4.32**	**7.68**	**5.96**

*Average of 300 leaves taken per observation

**Average of 100 panicles taken per observation

Table 4: Intensity of leaf and neck blast (*Magnaporthe oryzae*) disease of rice at different locations in Kashmir during 2011-13.

District	Location	Leaf blast intensity (%)*				Neck blast intensity (%)**			
		2011	**2012**	**2013**	**Mean**	**2011**	**2012**	**2013**	**Mean**
Anantnag	Anantnag	36.66	33.68	40.34	36.89	3.80	5.80	3.90	4.50
	Duroo Shahabad	34.30	32.00	35.82	34.04	4.70	4.60	5.20	4.83
	Larnoo	9.45	7.90	17.25	11.53	3.00	3.70	2.60	3.10
Mean		**26.80**	**24.53**	**31.14**	**27.49**	**3.83**	**4.70**	**3.90**	**4.14**
Pulwama	Kakapora	12.92	4.35	11.46	9.58	1.02	0.70	1.72	1.15
	Pampore	13.15	8.84	20.32	14.10	1.50	1.30	0.80	1.20
	Pinglina	14.26	8.67	15.69	12.87	0.60	1.20	0.60	0.80
Mean		**13.44**	**7.29**	**15.82**	**12.18**	**1.04**	**1.07**	**1.04**	**1.05**
Bandipora	Ajus	15.26	7.19	14.64	12.36	1.00	0.80	0.50	0.77
	Bandipora	9.10	6.46	17.48	11.01	1.60	1.40	0.80	1.27
	Potushai	8.84	5.21	13.46	9.17	0.70	0.90	1.00	0.87
Mean		**11.07**	**6.29**	**15.19**	**10.85**	**1.10**	**1.03**	**0.77**	**0.97**
Kulgam	Khudwani	32.71	18.22	27.99	26.31	4.50	4.20	3.80	4.17
	Kulgam	33.00	22.17	31.98	29.05	2.50	4.00	3.10	3.20
	Yaripora	33.78	28.82	37.64	33.41	2.90	3.10	3.80	3.27
Mean		**33.16**	**23.07**	**32.54**	**29.59**	**3.3**	**3.77**	**3.57**	**3.55**
Pooled mean		**21.12**	**15.30**	**23.67**	**20.03**	**2.32**	**2.64**	**2.32**	**2.43**

*Figures based on observations on 300 leaves

**Figures based on observations on 100 panicles

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