Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 6 Special issue [1] 2017: 370-373
©2017 Academy for Environment and Life Sciences, India
Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.533
Universal Impact Factor 0.9804
NAAS Rating 4.95

FULL LENGTH ARTICLE **OPEN ACCESS**

Prevalence of Rice blast (*Magnaporthe oryzae*) incidence in South India

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ABSTRACT
Rice is a staple food crop for majority of human population worldwide. Significant grain yield losses are reported due to blast disease caused by Magnaporthe oryzae across all crop growing areas of the world. Though, presently available blast management strategies reduce disease significantly, blast epidemics are still common, thereby causing devastating yield losses. Our present study therefore aimed at determining the prevalence of rice blast disease incidence in different districts of Telangana and Andhra Pradesh. Among the sampled areas, Per cent rice blast disease index ranged from 50.0 to 74.0%. Overall, our results as per the survey conducted during Kharif 2014 in Telangana and Andhra Pradesh indicated that blast severity was highest on HR-12 and least in BPT-5204. Our research results on variability of blast pathogen will be useful in devising location specific disease management strategies for rice blast.
Key Words: *Rice blast, Magnaporthe oryzae, Percent disease index, severity*

Received 20.07.2017 Revised 29.07.2017 Accepted 23.08. 2017

INTRODUCTION

Rice (*Oryza sativa* L.) is the world's most important crop and a primary source of food for more than half of the world's human population. More than 90% of the world's rice is grown and consumed in Asia (Kole, 2006). Rice is widely cultivated in China followed by India, Indonesia, Bangladesh, Vietnam, Thailand, Myanmar (Khush, 1997). The crop occupies about 165.2 M ha worldwide, with an annual production of 740.9 Mt and a productivity of 4485.87 Kg ha^{-1} (FAOSTAT, 2013). Rice is a rich source of protein, carbohydrate, dietary fiber, minerals and vitamins (Gopalan *et al*., 2007).

In Andhra Pradesh, the crop is grown to an extent of 3.62 M ha with a production of 11.4 Mt and productivity of 3173 Kg ha^{-1} (IPNI, 2013). In India, the productivity of rice is less than those in agriculturally advanced countries. This is attributed to the poor agronomic practices and partially due to biotic and abiotic stresses (Garret, 1965). Rice crop is frequently affected by about 50 diseases which include 6 bacterial, 21 fungal, 4 nematodes, 12 viral and 7 other diseases and disorders (Hollier *et al*., 1993; Webster and Gunnell, 1992) However, major diseases are rice blast, brown spot, bacterial leaf blight, sheath blight, sheath rot, Bakanae, stem rot, tungro, false smut and post-harvest diseases (Sharma and Bambawale, 2008). It is estimated that about 14-18% grain yield losses were caused by these diseases worldwide (Mew and Gonzales, 2002).

Rice blast is one of the most important diseases of rice worldwide and is one of the major hindrances for profitable rice production (Dar *et al*., 2011). The disease is caused by a filamentous, ascomycete fungus *Magnaporthe oryzae* (syn: *Pyricularia oryzae* Cav.) and is reported from more than 85 countries of the world (Gilbert *et al*., 2004 and Scardaci *et al*., 1997). Several rice blast epidemics have occurred in different parts of the world, resulting in 50 to 90 % of the grain yield losses (Agrios, 2005; Mehrotra, 1998; Robert, 1991 and Chaudhary *et al*., 1994). There was a severe epidemic of rice blast in 1978, when incidence of panicle blast was more than 40% in some cultivars.

Blast was first recorded in India during 1913 and a devastating epidemic occurred in 1919 in the Tanjore delta of Tamil Nadu (Padmanabhan, 1965). Seven epidemics of blast occurred between 1980 and 1987 in four states, two each in Himachal Pradesh, Andhra Pradesh and Tamil Nadu and one in Haryana, causing heavy yield losses (Nagarajan, 1988). Rice blast disease often causes outbreak in February, due to low night temperatures of 22 to 23ºC and long dew appearance during the day. In August, heavy damage of

blast disease is due to light drizzling for many days in most of the areas (Kim and Kim, 1993). Blast disease is known to attack nearly all the above ground parts of the plant and all the crop growth stages.

MATERIALS AND METHODS

Collection of rice blast diseased specimens

A roving survey was carried out in different districts of Telangana and Andhra Pradesh on different rice cultivars (Table 1) during kharif 2014 to assess the incidence of the blast disease and also to collect the blast infected leaf samples to study the variability of *M. oryzae*. Three samples were collected from Khammam, two samples each from Warangal, Guntur, Nalgonda, Mahbubnagar, Kurnool and one sample each from Medak, Adilabad, Rangareddy, Nellore, West Godavari, Nizamabad and Srikakulam. Data sheets were used to record the details such as crop cultivar, place of collection, disease severity and percent disease index. Leaf samples were collected from both farmers' fields and research stations. The samples were collected in polythene bags and brought to the laboratory for isolation and identification of the blast pathogen.

Scale used for rating of blast disease (IRRI-1996).

0. No lesion observed (Highly Resistant)
1. Small brown specks of pin point size (or) larger brown specks without sporulating centre (Resistant)
2. Small roundish to slightly elongated, necrotic gray spots, about 1-2 mm in diameter, with a distinct brown margin. (Moderately Resistant)
3. Lesion type is the same as in scale 2, but significant numbers of lesions are on the upper leaves (Moderately Resistant)
4. Typical susceptible blast lesions of 3 mm or longer, infecting less than 4% of leaf area (Moderately Susceptible)
5. Typical blast lesions infecting 4-10% of the leaf area (Moderately Susceptible)
6. Typical blast lesions infecting 11-25% of the leaf area (Susceptible)
7. Typical blast lesions infecting 26-50% of the leaf area (Susceptible)
8. Typical blast lesions infecting 51-75% of the leaf area many leaves are dead (Highly Susceptible)
9. Typical blast lesions infecting more than 75% leaf area affected (Highly Susceptible)

Percent disease index will be calculated by using the following formula:

$$PDI = \frac{\text{Sum of the scores}}{\text{Number of observations x highest number in rating scale}} \times 100$$

RESULTS AND DISCUSSION

A roving survey was carried out in different districts of Telangana and Andhra Pradesh across the different rice cultivars to assess the Per cent disease index and the results are presented in Table 1. From the surveyed areas, *M. oryzae* isolates were isolated from the diseased leaf samples and designated as MG1 to MG20 (Table 1). Among the sampled areas, Per cent rice blast disease index ranged from 50.0 to 74.0%. Highest PDI was observed on HR12 (74%) cultivated at Indian Institute of Rice Research (IIRR), Rajendranagar, Hyderabad. Followed by MTU 1010 from Madhira which recorded a PDI of 73.11%. However, the differences in PDI between HR-12 and MTU 1010 were non-significant. The blast incidence on other cultivars from Medak (MG2), Bapatla (MG4), Adilabad (MG7), Mahbubnagar (MG8), Nandyal (MG9), Mahanandi (MG10), Nellore (MG12), A. P. Rice Research Institute, Maruteru (MG13 isolate), Nizamabad (MG14), Palem (MG15), Piduguralla (MG19) and Agricultural Research Station, Ragolu (MG20) were with PDI values ranging from 61.33 to 69.26% which were non-significant. The PDI of the blast disease sampled from these areas also did not differ from HR-12 collected from IIRR and MTU-1010 from Madhira . The PDI for the blast incidence on rice from the other areas were in the range of 41.67% (Wyra) to 59.96% (Atmakur). There were non-significant differences among the PDI values on blast disease severity on rice cultivars from areas such as Khammam (50%), Atmakur (59.96%), Wyra (41.67%), Nalgonda (42.22%), Aleru (50%) and Warangal (50.18%). Overall, during Kharif 2014, the blast incidence on rice was severe in both Telangana and Andhra Pradesh as indicated by the mean leaf blast scale.

None of the cultivars cultivated in both the states under study were neither resistant nor moderately resistant on 0-9 scale. All the cultivars sampled in these surveyed areas have shown leaf blast susceptibility reaction of above 4. The leaf blast disease severity scale ranged from 3.3 to 7.3.

Table 1. Severity of rice blast disease on different rice cultivars in Telangana and Andhra Pradesh during Kharif 2014

Village/Mandal/District	Isolate Identity No	Cultivar	Rice blast	
			Severity scale	Per cent disease index (PDI)
Khammam (T)	MG1	MTU-1001	5.4	50.00 (44.83)*
Medak (T)	MG2	MTU-1001	4.8	62.78 (52.45)
Atmakur (T)	MG3	WGL - 44645	5.3	59.96 (50.74)
Bapatla (AP)	MG4	BPT-5204	4.9	61.85 (51.89)
Wyra (T)	MG5	MTU-1001	3.6	41.67 (40.15)
Nalgonda (T)	MG6	BPT-5204	3.3	42.22 (40.48)
Adilabad (T)	MG7	MTU-1001	5.84	64.67 (53.54)
Mahbubnagar (T)	MG8	MTU-1001	5.06	62.00 (51.98)
Nandyal (AP)	MG9	MTU-1001	5.6	65.78 (54.28)
Mahanandi (AP)	MG10	MTU-1001	5.2	69.26 (56.54)
IIRR (T)	MG11	HR12	7.14	74.00 (59.64)
Nellore (AP)	MG12	NLR-145	5.84	61.33 (51.61)
Maruteru (AP)	MG13	MTU-1001	6.2	62.67 (52.36)
Nizamabad (T)	MG14	MTU-1001	6.5	63.67 (52.95)
Palem (T)	MG15	MTU-1010	6.1	64.26 (53.44)
Madhira (T)	MG16	MTU-1010	7.3	73.11 (58.85)
Aleru (T)	MG17	BPT-5204	3.6	50.00 (44.98)
Warangal (T)	MG18	WGL-44645	4.1	50.18 (45.09)
Piduguralla (AP)	MG19	MTU-1010	6.04	69.00 (56.20)
Ragolu (AP)	MG20	BPT-5204	4.5	61.67 (51.81)
			Mean	**60.50**
			SE (m)	**2.983**
			CD	**10.090**

T=Telangana; AP=Andhra Pradesh

Leaf blast incidence was recorded on 0-9 scale (IRRI, 1996)

*Figures in the parenthesis are angular transformed values

Cultivar-wise, the mean blast disease severity as indicated by PDI ranged from 53.93 (BPT5204) to 74.00 (HR12). For the remaining cultivars, the PDIs during Kharif 2014 were 55.07 (WGL44645), 60.28 (MTU1001), 61.33 (NLR145) and 68.79 (MTU1010). Overall, our results as per the survey conducted during Kharif 2014 in Telangana and Andhra Pradesh indicated that blast severity was highest on HR-12 and least in BPT-5204.

Gashaw *et al*., 2014 conducted a survey and recorded the maximum disease incidence and severity in west Wollega zone with 63.03 and 34.60%, and lowest disease incidence and severity was recorded in Awi zone with 46.7 and 15.7%, respectively. The prevalence and distribution of blast disease caused by *Magnaporthe grisea*. Maximum disease incidence of 25% and severity of 15% of nodal blast and maximum incidence 25% of most destructive phase - neck blast was recorded from the district Kupwara (Dar *et al*., 2010).

ACKNOWLEDGEMENTS

This research is a part from the fist author's M.Sc. (Ag.) work. The authors gratefully acknowledge the support of ICAR, Govt. of India for granting financial support during M.Sc. (Ag.) programme.

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CITATION OF THIS ARTICLE

Ch. Yashaswini, P. Narayan Reddy, B. Pushpavati, Ch. Srinivasa Rao and M. Seshu Madhav. Prevalence of Rice blast (Magnaporthe oryzae) incidence in South India. Bull. Env. Pharmacol. Life Sci., Vol 6 Special issue 1, 2017: 370-373