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Survey on Rice Blast and Morphological Characterization of *Magnaporthe oryzae oryzae*

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Authors' contributions

This work was carried out in collaboration among all authors. Author ZN conducted the research work. Author FMA designed and supervised the study and edited the manuscript. Author KA wrote the methodology. Authors MKR and LL managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To survey and study morphological characterization of rice blast caused by *Magnaporthe oryzae oryzae* (MoO) that has become a major factor limiting rice yield throughout the world.
Study Design: Complete Randomized Design (CRD).
Place and Duration of Study: Mycology Laboratory, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka from June 2018 to December 2019.
Methodology: A survey was done in three northern districts of Bangladesh namely Gaibandha (Gobindogonj and Mohimagonj), Dinajpur (Birampur) and Bogura (Dupchanchia), disease incidence and severity was recorded and samples were collected. Five different media including Water Agar (WA), Potato Dextrose Agar (PDA), Potato Sucrose Agar (PSA), Rice flour Yeast Agar (RfYA) and Oat Meal Agar (OMA) were used to culture MoO. Colony characters like growth character, color, surface structure and shape of 28 MoO isolates were recorded in PDA.
Results: Among the three surveyed districts, the highest incidence (84.26%) of blast was recorded from Gobindogonj with a severity score of 7. The highest severity score 9.00 (65%) of blast was recorded in Mohimagonj where blast incidence was only 29.12%. Among the five different growth

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media highest mycelia growth was observed in Oat Meal Agar (20 mm) and lowest in Water Agar (10mm) at 7 DAI. Colony color of all the isolates was whitish grey to blackish with sufficient growth and the average colony diameter was 50 mm.

Conclusion: The results of the present study demonstrate that there is a certain level of morphological diversity such as mycelial growth rate and colony characters like color, surface structure and shape exists among isolates of MoO.

Keywords: Isolates; Magnaporthe oryzae oryzae (MoO); media; morphology; pathogenicity; rice blast.

1. INTRODUCTION

Rice (*Oryza sativa* L.) is a staple food for half of the world's population [1]. In Bangladesh, rice is the central to Bangladesh's economy, accounting for nearly 20 percent of gross domestic product (GDP) and providing about one-sixth of the national income of Bangladesh [2]. Blast is caused by *Magnaporthe oryzae oryzae* (MoO) Sac. is the most important fungal disease that occurs in all rice growing regions. Rice blast was first recorded in China (1637) later from Japan (1704). This pathogen infects all developmental stages and all organs of the rice plant [3,4]. The pathogen also infect neck and panicles during maturity stage of the crop resulting chaffyness of the panicles and discoloration of grain resulting reduction in the yield of rice [5]. The disease is generally considered as the major disease of rice because of its wide spread distribution and its destructiveness under favourable environmental conditions. Rice blast (*Magnaporthe oryzae*) is a key concern in combating global food insecurity given the disease is responsible for approximately 30% of rice production losses globally the equivalent of feeding 60 million people. These losses increase the global rice price and reduce consumer welfare and food security [6].

Incidence and severity of blast disease is increasing especially in the Boro season. In recent years, in Bangladesh, frequency of blast occurrence has increased with invasion into new areas (north and northwest parts of the country). The most popular and mega varieties BRRI dhan29 and BRRI dhan28 are recognized highly susceptible to blast disease [7]. Moreover, all local and improved aromatic rice varieties grown in wet season are vulnerable to neck blast [8,9].

The disease outbreak depends on the weather and climatic conditions of the various regions. The disease's occurrence and symptoms vary from country to country [10] stated that blast symptoms appear at all stages of plant growth. Lesions are typically spindle- shaped on leaves, wide at the center and pointed towards either ends. Large lesions usually develop a diamond shape with greyish center and brown margin. Under favorable conditions, lesions on the leaves expand rapidly and tend to coalesce, leading to complete necrosis of infected leaves giving a burnt appearance from a distance.

Pathogenic variability in the blast affected area is a prerequisite for identifying genotypes with a stable resistance to the variable pathogen population. It is important from an ecological, epidemiological and breeding perspective to know how genetic diversity is maintained and how new, well-adapted complex races arise in the pathogen population. For these knowledge survey is a must. Growing disease resistant varieties is most relevant and cost effective for the resource poor and marginal farmers. For developing resistant varieties, there is need to have clear understanding of the morphology of the pathogen, including growth and cultural parameters and their virulence. The present study was therefore conducted i. To determine incidence and severity of rice blast, ii. To find out the variation of MoO isolates on different media and iii. To determine the morphological, cultural and pathogenic characterization of MoO.

2. MATERIALS AND METHODS

2.1 Experimental Site

The experiment was conducted in the Laboratory, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka.

2.2 Experimental Period

The experiment was conducted during the period from June 2018 to December 2019.

2.3 Survey, Sampling and Recording Blast Incidence and Severity

Survey and sample was collected from forty farmers' fields of selected areas of Bangladesh

namely Gaibandha (Gobindogonj and Mohimagonj), Dinajpur (Birampur) and Bogura (Dupchanchia) during Boro (November to May; irrigated ecosystem) and Transplanted Aman (July to December; rain fed ecosystem). In each season, survey was conducted during pre-flowering stage of the rice crop to observe leaf and node blast. Soil type, cropping pattern and cropping intensity were taken into consideration in order to select locations. Ten fields or plots from each location were selected with each field having a size of at least 1500 square meter. In each location and season, intensive rice areas under rain fed and irrigated conditions were selected.

For the survey of blast disease, a zigzag sampling pattern was followed in this study [11] at every 50-step interval a single hill (consists of several tillers/plant) was selected and recorded for disease incidence and severity.

Disease incidence of blast disease across all selected locations was recorded followings [12]. Disease incidence was assessed using the following formula:

$$\text{Disease incidence (\%DI)} = \frac{\text{Total number of infected plants}}{\text{Total number of plants}} \times 100$$

Assessment of the disease severity in the field from each unit plot were randomly selected and tagged for grading the severity of diseases. Disease severity of leaf blast of rice was recorded following [13] used a 0-9 scale as follow: 0 = no lesion observed; 1 = 1% leaf area covered; 3 = 10% leaf area covered; 5 = 25% leaf area covered; 7 = 50% leaf area covered and 9 = more than 50% leaf area covered.

2.4 Isolation and Identification of Causal Agent

Samples of typical blast symptoms on rice leaves were collected from three different rice growing northern districts of Bangladesh. The infected portion was cut into small pieces and surface sterilized by dipping in 0.1% $HgCl_2$ or 10% Clorox for 1 min. and rinsed three times with sterile distilled water. The tissues were place in moist filter paper in plastic petridish (Fig. 1) and incubate at 25°C for 48 hours and conidia were transferred on water agar by observing the plate under stereo microscope (Fig. 2). After that mycelia tip from water agar was transferred on Oatmeal agar and was subcultured and incubated at 25°C for 7 to 10 days. The isolates were identified based on the morphological and cultural characteristics. Fine tip needle was used to pick the conidial masses and placed in glass slide. Then the slide was observed under compound microscope with cover slip. After confirming microscope examination, single conidium was transferred to establish monoconidial isolate on potato dextrose agar (PDA) media.Similarly, [14] collected the panicles with the symptoms of neck blast, washed once with sterile distilled water, and placed on moist filter paper in Petri dishes at room temperature to induce sporulation. Conidia from the lesion surface were spread onto 3% water agar with a sterile loop and incubated overnight. Single germinating conidium was isolated and transferred to potato dextrose agar.

2.5 Media Used for Culturing *Magnaporthe oryzae oryzae* (MoO)

The Northern isolate of MoO was grown on PDA for 10 days at room temperature. From the margin of actively growing fungus, 5-mm discs were plugged out. Sterile Petri dishes containing Water Agar (WA), Potato Dextrose Agar (PDA), Potato Sucrose Agar (PSA), Rice flour Yeast Agar (RfYA) and Oat Meal Agar (OMA) (Table 1) were inoculated each with a single 5-mm disc of the fungus and incubated at room temperature for 7 days. Three replications were maintained for each medium. The fungal growth was measured at 7 DAI. Further, the colony characters of the 28 isolates were grown on PDA and their colony morphology was observed.

2.6 Pathogenicity Study

Pure culture of each isolates are grown on OMA for 30 days at 25°C under alternating 14 hour of fluorescent light and 10 hour dark cycle to induce sporulation [15]. The conidial suspension was harvested, filtered and centrifuged at 5000 rpm. The mass of spore sedimentation was collected, resuspended with sterilized distilled water and spore density was adjusted to a concentration of 1×10^5 spore/ml using hemacytometer. The conidial spore suspension was sprayed at 3-4 leaf stage on rice leaves cv. BRRI dhan28 and US2 in pot and the seedlings were placed under glass house condition at 25^0C. The sterile water was used instead of spore suspension served as control under *in vitro* condition. Seedlings were evaluated after 7 days of inoculation.

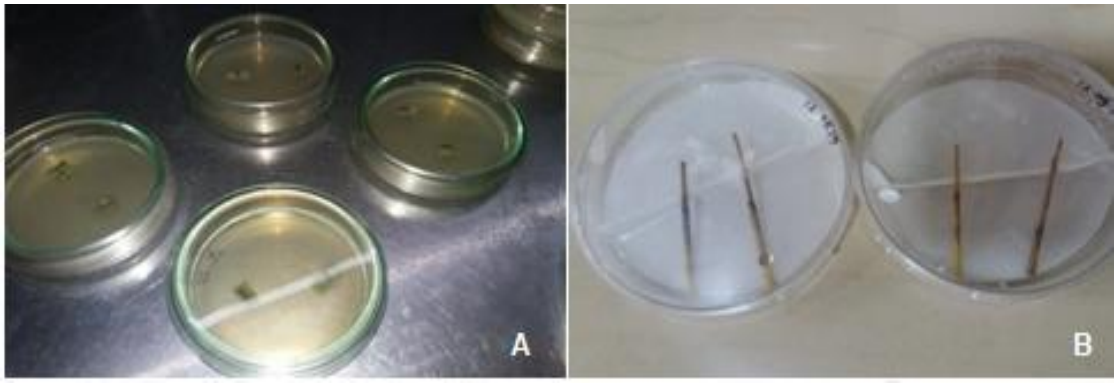

Fig. 1. Placement of infected leaf (A) and neck portion (B) in water agar media and moist chamber respectively

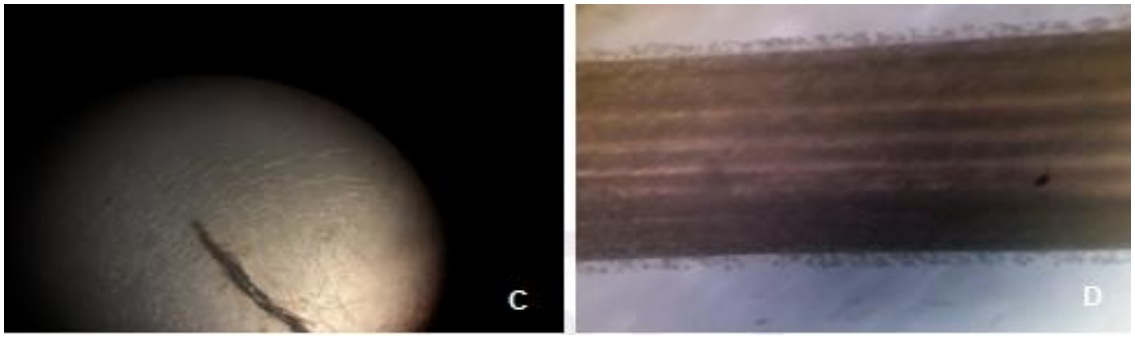

Fig. 2. Microscopic view of mycelial growth on water agar media (C) and on neck (D) portion

Table 1. Media used for culturing *Magnaporthe oryzae oryzae* (MoO)

Water Agar (WA)Composition	**Quantities (g / litter)**
Water	1 L
Agar	20g
Potato Dextrose Agar (PDA)Composition	**Quantities (g / litter)**
Potato (peeled and sliced)	200g
Dextrose	20g
Agar-agar	20g
Distilled water	1 L
Potato Sucrose Agar (PSA)Composition	**Quantities (g / litter)**
Potato (peeled and sliced)	200g
Sucrose	20g
Agar-agar	20g
Distilled water	1 L
Rice flour Yeast Agar (RfYA)Composition	**Quantities (g / litter)**
Rice polish	15g
Yeast extract	4g
Agar	20g
Water	1 L
Oat Meal Agar (OMA)Composition	**Quantities (g / litter)**
Oat Meal	60g
Agar	12.5g
Water	1 L

2.7 Measuring Mycelial Growth Rate of *Magnaporthe oryzae oryzae*

One very generally adopted method of measuring the growth of fungi is to inoculate fungus on culture media on a Petri dish and to measure the diameter of the colony a few days later. The growth rate was calculated from the diameter of the colony measured in a specific days after inoculation [16].

2.8 Experimental Design and Statistical Analysis

The experiment was done following Complete Randomized Design (CRD) with three replications and statistical analysis was done using Statistix10 software. Treatment means were compared by Duncan's New Multiple Range Test (DMRT).

3. RESULTS AND DISCUSSION

3.1 Survey on Rice Blast Disease

In Boro 2018-19 and Aman 2019, a survey was done in different three districts of Bangladesh in northern zone. The incidence and severity of leaf and neck blast recorded during survey is shown in Table 2.

From the survey, in case of Gobindogonj upazila under Gaibandha districts, highest incidence was recorded in field 1 (84.26%) cultivated with BRRI dhan28 followed by field 6 (70.61%) cultivated with BRRI dhan81 and field 7 (62.16%) cultivated with BRRI dhan28 whereas lowest incidence was recorded in field 9 (13.56%) cultivated with BRRI dhan28 and no incidence was found in field 2 and field 5 cultivated with BRRI dhan29. In case of Mohimagonj upazila under Gaibandha district, highest incidence was recorded in field 5 (79.36%) cultivated with BRRI dhan28 followed by field 8 (58.86%) cultivated with BRRI dhan28 whereas lowest incidence was recorded in field 3 (13.56%) cultivated with BRRI dhan29 and no incidence was found in field 1 and field 6 cultivated with BRRI dhan28. In case of Birampur upazila under Dinajpur district, highest incidence was recorded in field 1 (81.84%) cultivated with BRRI dhan28 followed by field 3 (64.23%) cultivated with BRRI dhan28 and field 10 (62.63%) cultivated with BRRI dhan81 whereas lowest incidence was recorded in field 6 (5.06%) cultivated with BRRI dhan29. In case of Dupchachia upazila under Bogura district, highest incidence was recorded in field 1 (60.24%) cultivated with BRRI dhan28 followed by field 7 (43.12%) cultivated with BRRI dhan64 and field 9 (37.29%) cultivated with BRRI dhan81 whereas lowest incidence was recorded in field 3 (14.93%) cultivated with BRRI dhan29 and no incidence was found in field 4 cultivated with BRRI dhan29. It is exposed that the highest incidence of blast was recorded from Gobindogonj (84.26%) and severity score was 7. The highest severity score of blast was observer in Mohimagonj (9) but the percent incident was only 29.12%.

The disease incidence varied among collection field sites and varieties and the causes could be the variation in weather condition, temperature, humidity, soil condition, soil management techniques etc. Differences between fields in management practices may also account for variation in disease incidence. Leaf blast infection and host evasion profoundly affected by temperature [17] and that play a key role in the epidemic of leaf blast [18,19]. The environment with frequent and prolonged dew periods and with cool temperature in day time is most favorable for the spread of the disease [20]. Similarly, weather conditions such as temperature and humidity might play major roles for rice blast disease expression and disease susceptibility declined significantly from the vegetative to reproductive stages and low temperatures generally did not produce disease symptoms [21]. Incidence and severity of blast disease of rice was recorded in ten agro-ecological zones (AEZs) of Bangladesh during Boro (irrigated ecosystem) and Transplanted Aman (rain fed ecosystem) seasons [22]. Disease incidence and severity was higher in irrigated ecosystem (Boro season) (21.19%) than in rain fed ecosystem (Transplanted Aman season) (11.98%) regardless of locations (AEZs). A survey on rice blast was conducted in 5 districts of Bangladesh namely Mymensingh, Kishoreganj, Barishal, Naogaon and Cumilla and among those Muktagachha, Mymensingh was found as the highest rice blast disease infected area and Bakerganj, Barishal was found as the lowest in Boro season 2017-2018 [23]. Temperature is reported as an important factor governing growth, reproduction and survival of the fungus [24]. A blast outbreak was also observed in the north-east, east, central, south and southwest parts of Bangladesh [25]. These areas vary in soil properties and some physical characteristics and Silicon content is comparatively low in these areas [26].

Table 2. Incidence and severity of rice blast at different location in Bangladesh in boro season, 2018-19 and aman season, 2019

Name of districts	Name of upazilas	Field sites	Name of varieties	Blast disease		
				Incidence (%)	Severity (%)	Degree of severity
Gaibandha	Gobindogonj	Field 1	BRRI dhan28	84.26	50	7
		Field 2	BRRI dhan29	0	0	0
		Field 3	BRRI dhan28	42.18	25	5
		Field 4	BRRI dhan63	16.78	4	1
		Field 5	BRRI dhan29	0	0	0
		Field 6	BRRI dhan81	70.61	50	7
		Field 7	BRRI dhan28	62.16	30	5
		Field 8	BRRI dhan28	30.80	10	3
		Field 9	BRRI dhan28	13.56	4	1
		Field 10	BRRI dhan28	21.16	6	1
Gaibandha	Mohimagonj	Field 1	BRRI dhan28	0	0	0
		Field 2	BRRI dhan29	12.83	6	1
		Field 3	BRRI dhan29	5.23	5	1
		Field 4	BRRI dhan81	18.13	12	3
		Field 5	BRRI dhan28	79.36	50	7
		Field 6	BRRI dhan28	0	0	0
		Field 7	BRRI dhan81	29.12	65	9
		Field 8	BRRI dhan28	58.86	30	5
		Field 9	BRRI dhan63	0	0	0
		Field 10	BRRI dhan28	22.62	5	1
Dinajpur	Birampur	Field 1	BRRI dhan28	81.84	10	3
		Field 2	BRRI dhan28	20.08	5	1
		Field 3	BRRI dhan28	64.23	40	7
		Field 4	BRRI dhan29	12.18	4	1
		Field 5	BRRI dhan28	30.18	10	3
		Field 6	BRRI dhan29	5.06	2	1
		Field 7	BRRI dhan28	10.12	2	1
		Field 8	BRRI dhan64	23.18	8	3
		Field 9	BRRI dhan28	18.15	6	1
		Field 10	BRRI dhan81	62.63	15	3

Name of districts	Name of upazilas	Field sites	Name of varieties	Blast disease		
				Incidence (%)	Severity (%)	Degree of severity
Bogura	Dupchanchia	Field 1	BRRI dhan28	60.24	10	3
		Field 2	BRRI dhan28	34.08	5	1
		Field 3	BRRI dhan29	14.93	40	7
		Field 4	BRRI dhan29	0	0	0
		Field 5	BRRI dhan29	20.16	10	3
		Field 6	BRRI dhan29	36.17	2	1
		Field 7	BRRI dhan64	43.12	2	1
		Field 8	BRRI dhan81	18.14	8	3
		Field 9	BRRI dhan81	37.29	10	3
		Field 10	BRRI dhan81	32.33	40	7

3.2 Confirmation of *Magnaporthe oryzae oryzae*

Typical two septate, three celled pyriform conidia was observed (Fig. 3). Similar findings were observed by other scientists where the conidia were found to show variations in septation, ranging from one to three septations and the majority of the conidia had three septations [27].

3.3 *In vitro* Mycelia Growth at Different Treatment Found Significantly Different

In vitro mycelia growth at different treatment found significantly different.

Mycelial growth of MoO was observed in *in vitro* condition in different growth media at 7 DAI. Highest growth was observed in Oat Meal Agar (20 mm) and lowest in Water Agar (10 mm) (Table 3 and Fig. 4).

Different solid media viz., potato dextrose agar, potato carrot agar, Kirchoff‟s, medium, Richard‟s medium, Sabourad‟s medium, Takahashii‟s medium, rice leaf extract agar and oat meal agar and liquid media viz., potato dextrose broth, potato carrot broth, Kirchoff‟s broth, Richard‟s broth, Sabourad‟s dextrose broth, Takahashii‟s broth and rice leaf extract broth was also used to culture rice blast pathogen [28]. Among all the solid media the highest mean mycelial growth of the fungus *Magnaporthe oryzae* (Cav.) was recorded on oat meal agar (77.6 mm) followed by rice leaf extract (75.9 mm) and least mean mycelial growth of the *M. oryzae* (Cav.) on Sabourad‟s media (44.7 mm) followed by Takahashii‟s media (52.5 mm). They were also agreed that highest mean mycelia growth of the fungus *Magnaporthe oryzae* (Cav.) was recorded on oat meal agar that are in agreement with our study. Studied that blast fungal isolates produced ring like, circular, irregular colonies with rough and smooth margins on oat meal agar media having buff colour, greyish black to black colour [29]. In another study, Potato dextrose and malt extract agar were found to be suitable for culturing different isolates of *Pyricularia oryzae* [30]. Colonies of *P. oryzae* appeared as white on oat meal, rice polish and malt extract agar, grey on potato dextrose agar and whitish grey on rice agar. It has been reported that, leaf blast fungus can attack the rice plant at any growth stage and among the different media prune agar (PA) and oat meal agar (OMA) were found to be the best for mycelial growth and sporulation [31]. The shape, color and compactness of the fungal colonies varied with the media and isolates.

3.4 Morphological Characterization of *Magnaporthe oryzae oryzae*

3.4.1 Mycelial growth of 19 isolates of MoO in PDA at 3 DAI

In vitro mycelia growth at different treatment found significantly different.

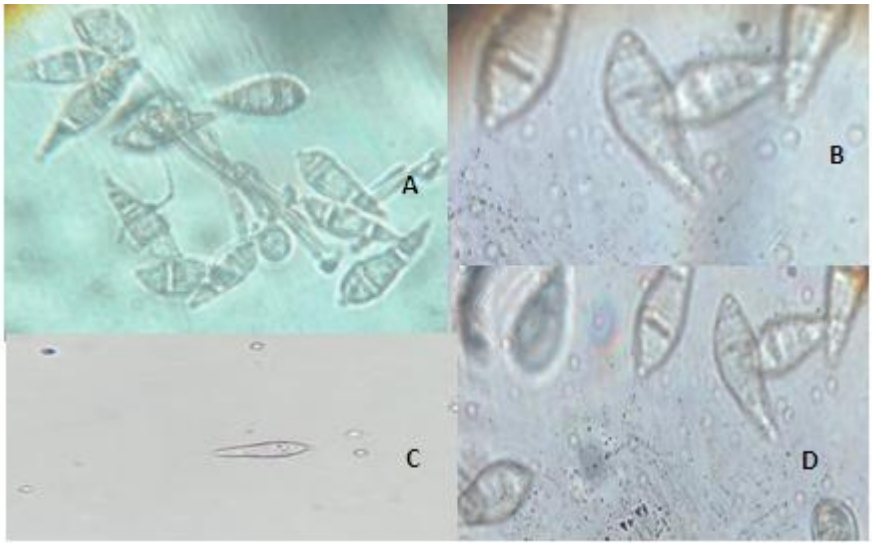

Fig. 3. Conidia of MoO under compound microscope at x40 (A, B, C, D)

Nineteen (19) isolates of MoO were cultured on Potato Dextrose Agar and their mycelia growth and growth rate were recorded (Table 4) and morphological characters like growth character, color, surface structure and shape were observed. Highest growth was observed in MoO 19 that was 24.67mm at 3 DAI and 8.22 mm per day growth with whitish ash colony color and smooth, cottony surface structure. Lowest growth was observed in MoO11 that was 13.33mm at 3 DAI and 4.44mm per day growth with light brown colony color and rough, velvety surface structure (Fig. 5).

3.4.2 Mycelial growth of 9 isolates of MoO in PDA at 7 DAI

Another 9 isolates of MoO isolated from the samples collected from Dupchanchia, Bogura were cultured on Potato Dextrose Agar (Fig. 6) and their mycelial growth and growth rate were recorded and morphological characters like growth character, color, surface structure and shape were observed (Table 5). Highest growth was observed in MoO28 that was 28.67mm at 7 DAI and 4.10mm per day followed by MoO27 (28mm at 7 DAI and 4mm per day) and lowest mycelium growth was observed in MoO23 (22.33mm at 7 DAI and 3.19mm per day). All the isolates were more or less similar in colony character, surface structure and shape those were whitish gray, smooth cottony and regular respectively. The findings of our study was similar with others who studied on *Pyricularia oryzae* (Po) that was isolated from infected leaf and panicle and identified based on cultural characteristics and conidia morphology and recorded that mycelial growth of four Po isolates varied significantly with fair to excellent sporulation ability [23].

Table 3. Mycelial radial growth of MoO in different growth media at 7 DAI

Culture media	Radial mycelial growth (mm) at 7 DAI
Water Agar (WA)	10 c
Potato Dextrose Agar (PDA)	16 b
Potato Sucrose Agar (PSA)	12 c
Rice flour Yeast Agar (RfYA)	14 b
Oat Meal Agar (OMA)	20 a
LSD (*P*= 0.05)	3.04

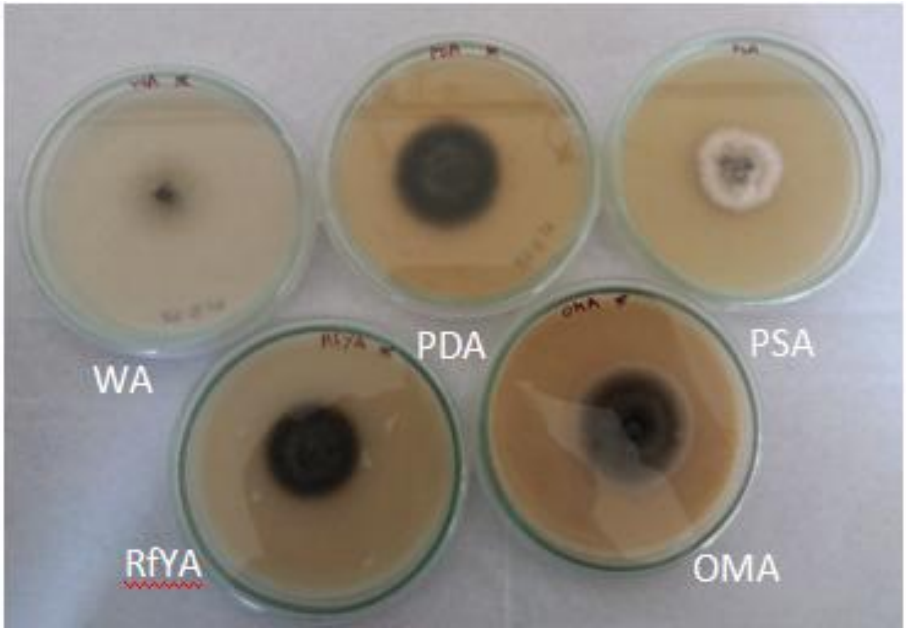

Fig. 4. Growth of MoO on different growth media at 7DAI; WA= water agar, PDA= potato dextrose agar, PSA= potato sucrose agar, RfYA= rice flour yeast agar and OMA= oat meal agar

Table 4. Morphological and cultural characters of 19 isolates of MoO on PDA

Isolates	Mycelial characters			Colony character		
	Growth (mm) 3DAI	Growth rate/day (mm)	Growth character	Color	Surface structure	Shape
MoO1	18.00 d	6.00 d	Medium	Whitish	Rough, velvety	Regular
MoO2	19.00 cd	6.33 cd	Poor	Brownish	Smooth, cottony	Irregular
MoO3	20.00 b-d	6.67 b-d	Medium	Greenish	Smooth, cottony	Regular
MoO4	18.00 d	6.00 d	Medium	Brownish	Rough, velvety	Regular
MoO5	24.00 ab	8.00 ab	Good	Whitish gray	Smooth, cottony	Regular
MoO6	24.00 ab	8.00 ab	Medium	Greenish	Smooth, cottony	Regular
MoO7	22.00 a-d	7.33 a-d	Medium	Whitish	Smooth, cottony	Irregular
MoO8	13.67 e	4.55 e	Poor	Light gray	Rough, velvety	Regular
MoO9	18.00 d	6.00 d	Poor	Greenish	Smooth, cottony	Regular
MoO10	22.00 a-d	7.33 a-d	Medium	Brownish	Smooth, cottony	Regular
MoO11	13.33 e	4.44 e	Poor	Light brown	Rough, velvety	Irregular
MoO12	20.67 a-d	6.89 a-d	Medium	Brownish	Smooth, cottony	Regular
MoO13	23.33 ab	7.78 ab	Medium	Greenish	Smooth, cottony	Regular
MoO14	22.00 a-d	7.33 a-d	Medium	Light brown	Rough, velvety	Regular
MoO15	22.00 a-d	7.33 a-d	Medium	Ash	Smooth, cottony	Irregular
MoO16	21.00 a-d	7.00 a-d	Medium	Whitish	Rough, velvety	Regular
MoO17	21.33 a-d	7.11 a-d	Good	Whitish	Smooth, cottony	Regular
MoO18	22.33 a-c	7.44 a-c	Good	Dark brown	Rough, velvety	Irregular
MoO19	24.67 a	8.22 a	Good	Whitish ash	Smooth, cottony	Regular
LSD(*P*= 0.05)	4.21	1.40				

Table 5. Mycelial radial growth of 9 isolates of MoO on pda at 7 DAI

Isolates	Mycelial growth (mm)	Mycelial growth rate/ day (mm)	Colony character		
			Color	Surface structure	Shape
MoO20	25.00 c	3.57c	Whitish gray	Smooth, cottony	Regular
MoO21	26.00 bc	3.71bc	Whitish gray	Smooth, cottony	Regular
MoO22	24.00cd	3.43 cd	Whitish gray	Smooth, cottony	Regular
MoO23	22.33 d	3.19d	Whitish gray	Smooth, cottony	Regular
MoO24	26.00 bc	3.71bc	Whitish gray	Smooth, cottony	Regular
MoO25	24.67 c	3.52c	Whitish gray	Smooth, cottony	Regular
MoO26	25.00 c	3.57c	Whitish gray	Smooth, cottony	Regular
MoO27	28.00 ab	4.00 ab	Whitish gray	Smooth, cottony	Regular
MoO28	28.67 a	4.10a	Whitish gray	Smooth, cottony	Regular
LSD(*P*=0.05)	2.21	4.42			

Fig. 5. Growth of 19 MoO isolates on PDA

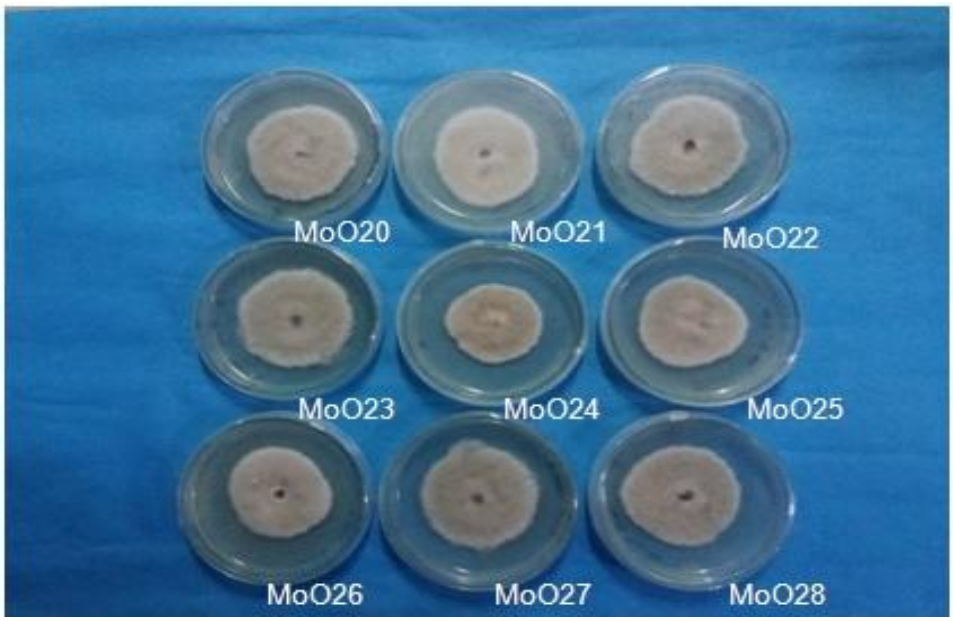

Fig. 6. Mycelial radial growth of nine MoO isolates on PDA at 7 DAI

4. CONCLUSION

In Boro 2018-19 and Aman 2019, a survey was done in three northern districts of Bangladesh namely Gaibandha (Gobindogonj and Mohimagonj), Dinajpur (Birampur) and Bogura (Dupchanchia).The highest incidence of blast was recorded from Gobindogonj (84.26%) where severity score was 7. The highest severity score of blast was recorded in Mohimagonj that was 9 with 65% severity but the percent incidence was only 29.12%. Highest growth was observed in Oat Meal Agar (20mm) and lowest in Water Agar (10mm) at 7 DAI. Colony characters like growth character, color, surface structure and shape of 28 isolates were observed in Potato Dextrose Agar (PDA). Colony color of all the isolates was whitish grey to blackish with sufficient growth and

the colony diameter 50mm average. The result of the present study demonstrates that there is a certain level of morphological diversity among isolates of MoO in northern region of Bangladesh.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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