

Research Article

A Field Investigation: Common Diseases and Threat for Maize Production

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Abstract

The study was conducted in major 20 maize growing districts of Bangladesh for analysis of maize diseases. In this study, twenty farmers per district were interviewed through pretested questionnaires for collecting data on maize diseases and diseased sample were collected for identifying causal organism. Isolations of causal organism were done in the M.S. laboratory, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka. The major and minor diseases were determined by observing the prevalence of diseases in the field and opinion expressed by the farmer. Considering the opinion of the farmers and field observations the 21 diseases of maize were identified including seedling blight, stalk rot, root rot, sheath blight, sheath rot, ear rot, bacterial leaf blight, may disleaf blight, Brown spot, taricum leaf blight, gray leaf spot, sugarcane mosaic, downy mildew, maize streak, maize stripe, maize dwarf mosaic, anthracnose, cob rot, store grain rot, cob sheath rot and cob sheath blight. The prevalent major diseases were stalk rot, leaf spot, root rot, cob rot, sheath blight, sheath rot, cob sheath blight, cob sheath rot, leaf blight, bacterial leaf blight, maize dwarf mosaic virus, corn stunt, leaf virus, maize streak virus. Seedling and reproductive stages were found more vulnerable to diseases. There was a positive and high degree of relationship among insect pest and disease incidence with weed infestation. The probable sources of maize diseases were seed borne diseases from outside of the country (cross boundary), imported hybrid seeds and infested soil. According to the opinion of the participants, proper training on quarantine diseases, improvement of quarantine laboratory and strengthening of quarantine law could be the best way for improvement of quarantine disease situation of maize.

INTRODUCTION

Maize is the third most important cereal crop in Bangladesh. The production of maize in Bangladesh is popularizing for its multifarious use for food, feed and edible oil Preparation. It covers 2.02 lakh hectares with a production of 13.17 lakh metric tons in 2010 [3]. The maize area has slowly expanded over the past few years due to its diversified use. This area would grow further to meet future food, feed, and other demands, especially in view of the booming livestock and poultry producing sectors in the country. Maize is a versatile crop grown over a range of agro climatic zones. However, the major maize production areas are located in temperate regions of the globe. The United States, China, Brazil and Mexico account for 70% of global production. In USA, EU, Canada and other developed countries, maize is used mainly to feed animal directly or sold to feed industry and as raw material for extractive/fermentation industries [2]. In fact in many countries it is the basic staple food and an important ingredient in the diets of people. Globally, it has been estimated that approximately 21% of the total grain produced is consumed as food. Bangladesh Agricultural Research Institute (BARI) has already released high yielding maize varieties like Bornli, Shuvra, KhaiBhutra, Mohor, BARI Bhutra-5, BARI Bhutra-6, BARI Hybrid variety-1, and then BARI Hybrid variety 9, 10, 11, 12 and more are on the pipe lines. Under the increasing trend of cultivation,

the demand for hybrid seed is increasing rapidly and these are being imported from other countries. Bangladesh is surrounded by India and Myanmar from three sides- west, north and east leaving Bay of Bengal on the south. These two neighboring countries, India and Myanmar, are also popular as maize growing countries. As such, there are potential risks of the presence and entry of harmful quarantine maize pests in our country. Hence, the quarantine pests and diseases are to be identified through Pest Risk Analysis (PRA) study. To satisfy the prerequisite the World Trade Organization (WTO) for maize trade, it is necessary to conduct pest risk analysis of maize in Bangladesh. Therefore, the study has designed to attain what kind of diseases affect the maize plant as well as to estimate their severity in maize production.

MATERIALS AND METHOD**Source of data and sampling procedure**

A systematic sampling procedure was used both baseline and nationwide survey. In Bangladesh 20 major maize growing districts were selected for conducting survey analysis on maize diseases. A pre-designed questionnaire was used to collect information on level of knowledge on diseases of maize aspects of farmers. The total sample size was 400.

Survey on diseases of maize in selected locations of bangladesh

The survey was covered with 40 upazilla of selected 20 districts shown in (Table 1).

In the survey program, 20 farmers were interviewed per district. Selection of farmers was done through discussion with Extension personnel (DAE).

Maize plantation of the selected farmer's field observed carefully and symptoms of the diseases recorded. In each upazilla 2 farmer fields was visited to find out present diseased condition. "Maize disease: A Guide for Field Identification (4th edition, 2004)" by CEMMYT was primarily used for disease identification in field.

Laboratory experiments

In the laboratory experiments, to identify the pathogen, diseased plant part was collected using sterilized polythene bags and brought to the laboratory and the sample washed thoroughly under running tap water and surface sterilized with 4% NaOCl. The diseased parts were then cut into 1.0 cm long pieces. One set of pieces were placed on three layers of wet blotters equidistantly in Perspex plates and another set placed on PDA medium. Both sets were incubated for 7 days under 12/12hr. alternate cycles of near ultra violet light and darkness at $22 \pm 2^\circ\text{C}$. After 8 days of incubation, the disease causal organism(s) were identified.

Data analysis

Data on different parameters were analyzed through computer software SPSS.

RESULTS AND DISCUSSION

Source of maize seeds used by the farmers for cultivation

Growers used maize seeds from different sources for cultivation. Among those most (86.75%) of the farmers used maize seeds from seed dealer. Other important sources were Agricultural Extension Department, Pesticide Dealer, directly from BRAC etc. opinion expressed by the 4.25%, 2.75% and 2.25% farmers (Table 2).

Major disease infections in the maize field

According to their opinion the major diseases were leaf spot, cob rot, leaf blight, sheath blight and bacterial leaf blight ranked first to fifth expressed by the 31.75 %, 26.50 %, 25.25 %, 19.25 % and 19.25%, farmers, respectively (Table 3).

Among these presences of diseases were leaf spot, leaf blight, cob rot, sheath blight and bacterial leaf blight ranked first, second, third, fourth and fifth expressed by the 36.30%, 32.00%, 25.30%, 22.50% and 21.80% farmers, respectively. More or less all stages of the maize crop were attacked by the diseases, where the dominating disease such as leaf spot, leaf blight and sheath blight caused infections at seedling, vegetative and reproductive stages, whereas bacterial leaf blight at vegetative and reproductive stages and cob rot caused infections at reproductive stage of the maize plants in the field. The infestation intensity of the

Table 1: Locations of the survey.

Sl. No.	Districts	Sample Upazilla		No. of Upazilla
		Name of Upazilla for survey		
1	Rangpur	Sadar	Mithapukur	2
2	Dinajpur	Sadar	Fulbari	2
3	Bogra	Sherpur	Adamdighi	2
4	Naogaon	Sadar	Patnitala	2
5	Rajshahi	Tanor	Godagari	2
6	Pabna	Sadar	Atgoria	2
7	Sirajgonj	Sadar	Ullapara	2
8	Jessore	Sador	Zikorghacha	2
9	Kushtia	Sador	Daulatpur	2
10	Jhenidah	Sadar	Harinakundu	2
11	Chuadanga	Jibonnagor	Damurhuda	2
12	Faridpur	Sadar	Nagorkanda	2
13	Tangail	Sador	Shakipur	2
14	Sherpur	Sadar	Nakla	2
15	Mymensingh	Muktagacha	Fulpur	2
16	Kishoreganj	Sadar	Kotiadi	2
17	Netrokona	Sadar	Purbadhala	2
18	Netrokona	Sadar	Purbadhala	2
19	Comilla	Sadar	Burichong	2
20	Chittagong	Mirersarai	Satkania	2

Table 2: Farmers opinion on the source of maize seeds used for cultivation.

Source of maize seeds	Response	
	No. of respondent [N=400]	% Response
1. Seed Dealer	347	86.75
2. Pesticide Dealer	11	2.75
3. BADC	2	0.50
4. Directly from BRAC	9	2.25
5. Directly from importer	-	-
6. Agriculture Extension Department	17	4.25
7. Research station	4	1.00
8. Local market seed	4	1.00
9. Farmers neighbor seed	2	0.50
10. Other sources	4	1.00
Total	400	100

maximum diseases was low to medium expressed by the most of the farmers. On the other hand, *Fusarium* ear rot caused damage with high intensity expressed by the 66.0% farmers (Table 3).

Use of quality seeds, storage and control measure of maize seed by the farmers for cultivation

The farmers participated in the survey; maximum (50.50%) of them checked the expiry date of the seeds used for cultivation. But a large portion (41.25%) of them did not reply about the checking of expiry date of seeds used for cultivation. On the other hand, only 6.25% of them expressed that they examined germination and quality tests of the seeds used for cultivation.

Maximum (55.50%) farmers expressed their opinion that they did not preserve maize seeds in storage. On the other hand,

40.25% farmers did not express their opinion about storage of maize seeds. Among 400 farmers, only 2.00% of them said that they took control measures against pests in stored maize seeds, whereas 32.75% farmers expressed their opinion that they did not take any control measures against pests in stored maize seeds. Nobody replied about applying any types of control measures against pest of maize seeds in storage (Table 4).

Most (80.25%) of the farmers expressed their opinion that there were positive relationships among insect pest, disease and weed infestation in the maize field, whereas only 19.75% farmers expressed their negative opinion. 50% of farmers expressed their positive idea about pests of maize presence in neighboring countries, i.e., the neighboring countries might play a role as sources from where they come in Bangladesh (Table 4).

Methods of disease control applied in the maize field

Among different methods applied for the management of maize pests in the field, most (95.00%, 86.67 and 31.67%) of the farmers applied pesticides to control insect pests, diseases and weeds, respectively; i.e., application of pesticides was the most

widely used method to control maize pests in the field (Table 5).

Incidence of diseases in stored maize seeds in storage

Only few expressed their positive attitude about the disease infection for stored maize. However, considering the opinion expressed by the farmers, the incidence of insect pests of maize seeds in storage were cob rot, grain rot and Aspergillus ear rot. But most of the diseases caused high damage to maize seeds. Polythene bag and earthen container were the most suitable containers for preventing disease infection of maize seeds in storage than other containers (Table 6).

Any idea about quarantine pest of maize coming from neighboring countries in Bangladesh

Most of the farmers (60.00%) expressed their positive idea about quarantine pests of maize coming from neighboring countries in Bangladesh, i.e., the neighboring countries were the main sources of quarantine pests those coming through crossing boundary and infesting maize crops in Bangladesh.

Among them, relax of quarantine law and weakness of the

Table 3: Farmers response on the major disease infections of maize.

Name of disease	Farmers' response on the major diseases				% Farmers' response on disease infection					
	No. of respondent [N=400]		% Response		Presence of disease	Stage of crop infected	Infection intensity			
	Yes	No	Yes	No			High	Medium	Low	Total
1. Stem rot	50	350	12.50	87.50	12.5	Seedling, vegetative, reproductive	8.0	14.0	78.0	100
2. Leaf spot	127	273	31.75	68.25	36.3	Seedling, vegetative, reproductive	1.4	31.0	67.6	100
3. Root rot	21	379	5.25	94.75	4.0	Seedling, vegetative, reproductive	12.5	12.5	75.0	100
4. Cob rot	106	294	26.50	73.50	25.3	Reproductive stage	19.6	20.0	60.4	100
5. Sheath blight	77	333	19.25	80.75	22.5	Vegetative and reproductive stage	6.6	35.6	57.8	100
6. Sheath rot	27	373	6.75	93.25	9.3	Vegetative and reproductive stage	13.5	32.4	54.1	100
7. Cob Sheath blight	43	357	10.75	89.25	10.0	Reproductive stage	-	30.0	70.0	100
8. Cob Sheath rot	32	368	8.00	92.00	7.3	Reproductive stage	-	20.7	79.3	100
9. Leaf blight	101	299	25.25	74.75	32.0	Vegetative and reproductive stage	3.1	30.5	66.4	100
10. Bacterial leaf blight	77	333	19.25	80.75	21.8	Vegetative and reproductive stage	4.6	13.8	81.6	100
11. Maize Dwarf Mosaic Virus	64	336	16.00	84.00	18.8	Vegetative stage	-	25.3	74.7	100
12. Grain rot	11	389	2.75	97.25	2.0	Reproductive stage	-	62.5	37.5	100
13. Store grain Rot	5	395	1.25	98.75	1.8	Reproductive stage	-	42.9	57.1	100
14. Aspergillus ear rot	8	392	2.00	98.00	1.3	Seedling, vegetative, reproductive	-	-	100.0	100
15. Fusarium ear rot	5	395	1.25	98.75	1.5	Seedling, vegetative, reproductive	66.0	-	33.3	100
16. Penicillium ear rot	9	391	2.25	97.75	3.8	Seedling, vegetative, reproductive	-	26.7	73.3	100
17. Stenocarpella ear rot	3	397	0.75	99.25	1.5	Seedling, vegetative, reproductive	-	66.7	33.3	100

18.	Corn stunt	28	372	7.00	93.00	5.5	Seedling, vegetative, reproductive	4.5	9.1	86.4	100
19.	Leaf Virus	28	372	7.00	93.00	5.5	Seedling, vegetative, reproductive	4.5	9.1	86.4	100
20.	Maize streak virus	59	341	14.75	85.25	14.8	Seedling, vegetative, reproductive	3.4	18.6	78.0	100
21.	Sugarcane mosaic virus	11	389	2.75	97.25	2.0	Seedling, vegetative, reproductive	-	25.0	75.0	100
22.	Downy mildew	11	389	2.75	97.25	3.8	Seedling, vegetative, reproductive	-	46.7	53.3	100
23.	Field Corn Nematode	-	-	-	-	0.5	Seedling, vegetative, reproductive	-	50.0	50.0	100
24.	Other disease	34	366	8.50	91.50						

Table 4: Farmers response on quality, storage and control measure of maize seed.

Farmers response		Types of response					
		No. of respondents [N=400]			% Response [100%]		
		Yes	No	Not replied	Yes	No	Not replied
quality seeds	Expiry date checked	202	33	165	50.50	8.25	41.25
	Germination & quality tested	25	195	180	6.25	48.75	45.00
storage of maize seed	Use preserve for storage	17	222	161	4.25	55.50	40.25
	Control measures taken against diseases and pests	8	131	261	2.00	32.75	65.25
	Types of control measures taken against diseases and pests	-	-	400	-	-	100
Relationship among insect pests, diseases and weed infestation in the maize field		321	79	-	80.25	19.75	-
Idea about the maize pests in neighboring countries		200	120	80	50	30	20

Table 5: Farmers response on the methods of disease control applied in the maize field.

Methods of pest control		Response on the methods applied			
		Nos. [N=240]		% Response	
		Yes	No	Yes	No
1.	Through pesticides	208	32	86.67	13.33
2.	Use of resistant variety	93	147	38.75	61.25
3.	Use of imported hybrid maize	104	136	43.33	56.67
4.	Use seed treatment	50	190	20.83	79.17
5.	Cultural practices & control measures	167	73	69.58	30.42
6.	Use of barriers to prevent dispersion	119	121	49.58	50.42
7.	IPM method	44	196	18.33	81.67
8.	Others (if any)	46	194	19.17	80.83

existing quarantine stations ranked first and second, respectively expressed by the 22.5 % and 15.00 % farmers. On the other hand, the respondents who had given positive idea, most of them (40.00 %) did not reply about the reasons for coming of quarantine pests from neighboring countries in Bangladesh through crossing boundary of neighboring countries (Table 7).

Considering the opinion expressed by the farmers, the incidence of diseases of maize in field were stem rot, leaf spot, root rot, cob rot, sheath blight, sheath rot, cob sheath blight, cob sheath rot, leaf blight, bacterial leaf blight, maize dwarf mosaic virus, grain rot, store grain rot, Aspergillus ear rot, Fusarium ear rot, Penicillium ear rot, corn stunt, leaf virus, maize streak virus,

sugarcane mosaic virus, and downy mildew. The incidences of disease of maize seeds in storage were cob rot, grain rot and Aspergillus ear rot and most of the diseases caused high damage to maize seeds. According to Bari and Alam [4] and Yasmim [12] there are 28 different disease of maize present in Bangladesh .Ali and Alam [1] also reported 30 diseases to occur on maize in Bangladesh. But during survey period, it was found only 13 different disease of maize. Disease incidences vary from season to season and all diseases are not appearing at same season. More or less all stages of the maize crops were attacked by the diseases, where the dominating disease leaf spot, leaf blight and sheath blight caused infections at vegetative and reproductive stages of

Table 6: Farmers' response on the disease attack in stored maize seeds.

Name of stored Diseases	Presence of pests	Response (%)								
		Level of damage			Types of container used for preventing pest attack					
		High	Medium	Low	Jute bag	Poly bag	Bamboo <i>dhole</i>	Tin	Earthen container	Total
1.Cob rot	1.5	67.0	16.50	16.50	16.25	67.5	-	-	16.25	100.0
2.Grain rot	1.0	50.0	25.0	25.0	-	50.0	-	-	50.0	100.0
3.Aspergillus ear rot	0.5	100.0	-	-	-	-	-	-	-	
4.Fusarium ear rot	-	-	-	-	-	-	-	-	-	
6. Store grain Rot	-	-	-	-	-	-	-	-	-	
7. Other diseases	-	-	-	-	-	-	-	-	-	

Table 7: Farmers on any idea about quarantine pests of maize.

Response	Opinion for quarantine pests of maize							
	Coming from neighboring countries		Possible reasons for coming of quarantine pests of maize from neighboring countries					
	Coming	Not coming	Relax of quarantine law	Weakness of the quarantine stations	Illegal introduction of seeds	Lack of proper seed health test	Seed importation	Not replied
No. of respondents [N=400]	240	160	90	60	50	20	20	160
% Response [100%]	60	40	22.5	15	12.5	5	5	40

the maize crops. Hossain [8] stated that six seedling diseases were mostly found in Bangladesh. The main source of maize seeds was the seed dealer. They believed that, the probable sources of maize diseases were seed borne diseases from outside of the country (cross boundary), imported hybrid seeds and infested soil.

Richardson [10] reported that important seed borne disease of maize are leaf spot, leaf blight, collar rot, kernel rot, seedling blight, anthracnose and head smut. Chatterjee et al. [6], reported that the major maize diseases prevalent in India are eight. Subbaiah et al. [11], reported 35 disease of maize present in India. According to Fakir [7], 11 seed-borne diseases occurring on maize in Bangladesh. Most (86.67 %) of the farmers applied pesticides to control diseases; i.e., application of pesticides was the most widely used method to control maize diseases in the field. Seed treatment was the other method for controlling maize diseases. Jha et al. [9], and Bohra et al. [5], recommended Bavistin as best seed treating chemical. According to farmer the quarantine diseases of maize were stalk rot, leaf spot, root rot, cob rot, sheath blight, sheath rot, cob sheath blight, cob sheath rot, leaf blight, bacterial leaf blight, maize dwarf mosaic virus, grain rot, store grain rot, Aspergillus ear rot, Fusarium ear rot, Penicillium ear rot, corn stunt, leaf virus, maize streak virus, sugarcane mosaic virus, and downy mildew. Among these ranked orders of top ten diseases were leaf blight, stem rot, leaf spot, cob rot, Aspergillus ear rot, sheath blight, downy mildew, stored grain rot, grain rot, and leaf virus.

CONCLUSION

Because of increasing demand, hybrid maize seed are being imported from abroad and thus there is risk of introducing quarantine diseases from other countries through seeds. The incidences of disease of maize in field were stalk rot, gray leaf spot, brown spot, root rot, cob rot, sheath blight, sheath rot, cob sheath blight, cob sheath rot, maydis leaf blight, Tarcicum leaf blight, bacterial leaf blight, maize dwarf mosaic virus, grain rot, store grain rot, Aspergillus ear rot, Fusarium ear rot, Penicillium ear rot, corn stunt, maize stripe, maize streak, sugarcane mosaic, and downy mildew. Major diseases of stored maize in Bangladesh were grain rot, cob rot, and stored grain rot. The existing quarantine diseases of maize were leaf stalk rot, leaf spot, root rot, cob rot, sheath blight, sheath rot, cob sheath blight, cob sheath rot, leaf blight, bacterial leaf blight, maize dwarf mosaic virus, grain rot, store grain rot, Aspergillus ear rot, Fusarium ear rot, Penicillium ear rot, corn stunt, leaf virus, maize streak virus, sugarcane mosaic virus, and downy mildew. Seed treatment was the best method of quarantine pest control of maize than the use of pest free imported hybrid seeds and cultural practices as control measures. The better management practices for disease control in maize were the spraying of fungicides and use of integrated Disease management (IDM) method. It is difficult to control quarantine disease but maintaining regular field visit, seed health test, proper training on quarantine diseases, strengthening of quarantine law, improvement of quarantine laboratory we can prevent entry of quarantine disease of maize.

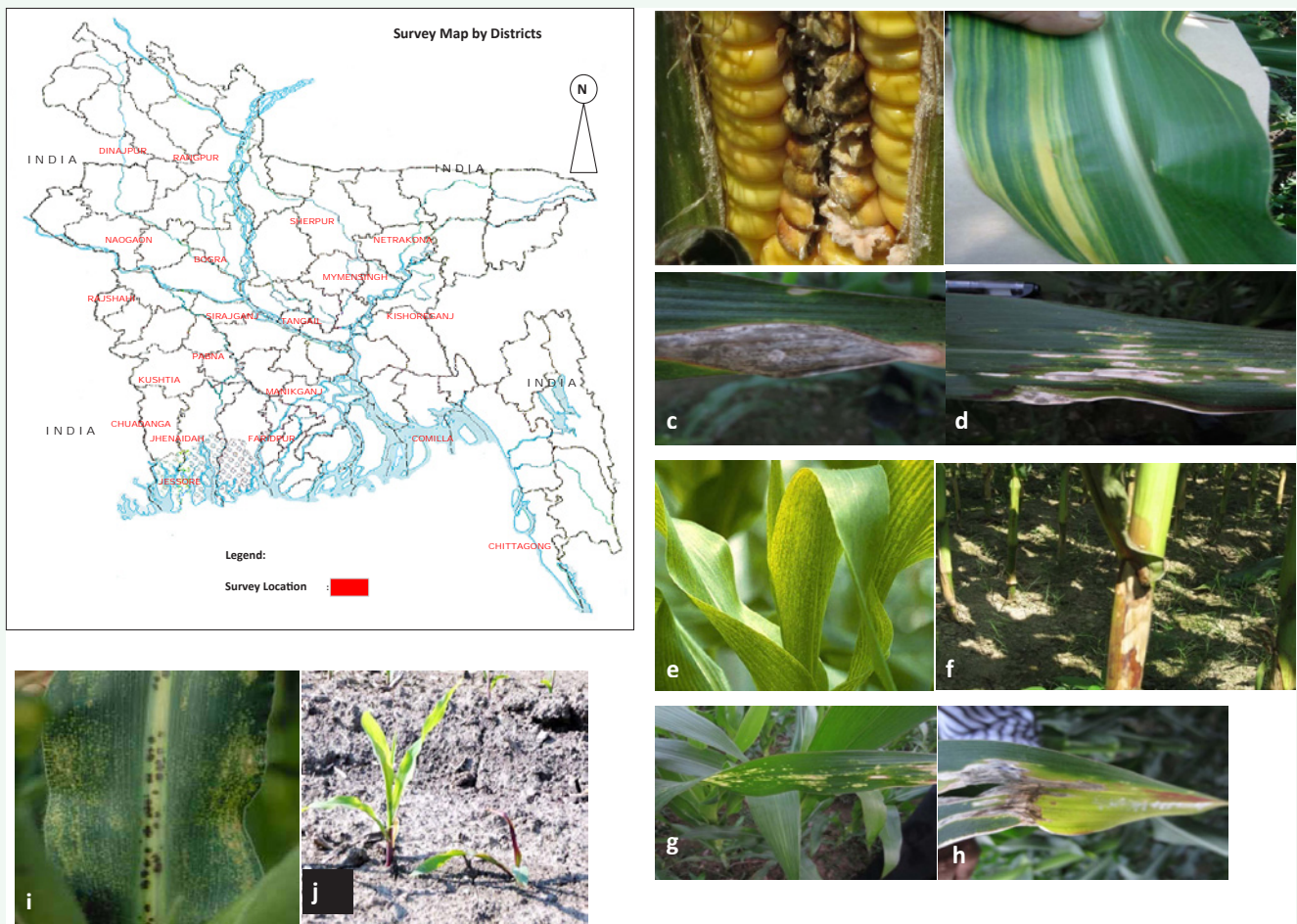


Figure 1 Some Common Maize disease [a. Ear rot, b.Maize stripe, c. Turicum leaf blight, d. Maydis leaf blight, e. Mosaic, f. Sheath blight, g. Gray leaf spot, h. Anthracnose, i. leaf brown spot and Seedling blight] in Bangladesh.

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