Journal of Bangladesh Academy of Sciences, Vol. 34, No. 2, 163-170, 2010

FUNGAL DISEASES OF THREE AROMATIC RICE (*ORYZA SATIVA* L.)

SHAMIM SHAMSI*, NAJMUN NAHER[1], PRANAMI CHOWDHURY[2] AND MST. SELINA MOMTAZ[3]

Department of Botany, University of Dhaka, Dhaka-1000, Bangladesh

ABSTRACT

Seeds of three aromatic rice (*Oryza sativa* L.) var. Kalijira, Kataribhog and BR 34 Jira dhan were tested by Blotter method for identifying their seed borne fungi. Fungi associated with seeds were *Aspergillus niger*, *Apergillus* sp., *Carvularia* sp., *Cladosporium* sp., *Colletotrichum* sp., *Fusarium* sp., *Pyrenochaeta oryzae* and *Sarocladium oryzae*. Infected samples were collected from the field starting from maximum tillering stage to grain filling stage of plant growth. After maximum tillering stage three fungal diseases were recorded on the stems and sheaths. Sheath rot was recorded on all the three rice varieties, stem rot was recorded on Kalijira and sheath blotch was recorded on Kataribhog. The pathogens of sheath rot, *Sarocladium oryzae*, sheath blotch, *Pyrenochaeta oryzae* and stem rot, *Sclerotium oryzae* were frequently associated with the respective samples. This is the first report of disease on aromatic rice plant for Bangladesh.

Key words: Fungal diseases, Aromatic rice

INTRODUCTION

In Bangladesh about 7000 varieties of rice are grown in various parts of the country. In general, rice is classified by its length, thickness and aroma. Aromatic rice is known for its characteristics fragrance when cooked and it fetches higher price in rice market than non aromatic rice (Ashrafuzzaman *et al.* 2009). Locally adopted varieties are Kalijira, Kataribhog and BR 34 Jira dhan have small grain and pleasant aroma. Aromatic rice varieties have occupied about 12.5% of total transplant Amon rice cultivation (Dutta *et al*. 2002).

Production cost of fine rice per acre is very low compared to coarse rice. Income potential is higher in aromatic fine rice cultivation, since it's cultivation does not normally require additional expenditure on fertilizer, pesticides and irrigation. The average yield of high yielding variety (HYV) Amon paddy is 1350 kg/acre while the average yield of fine rice is 800 - 920 kg/acre (Shakeel *et al*. 2005). It is to be mentioned here that aromatic rice is closely related to social and cultural heritage of Bengalees and it is consumed during different festivals, weddings and entertaining guests (Sarker 2002).

Although lots of research information are available on different rice varieties but such reports are scanty on aromatic rice. Present work targeted for an investigation on fungal diseases of three aromatic rice varieties. Kalijira, Kataribhog and BR 34 Jira dhan.

* Corresponding author: <Prof.shamsi@gmail.com>.
[1] Department of Botany, Life & Earth Science Group, National University, Gazipur-1704, Bangladesh.
[2] Department of Botany, Jagannath University, Dhaka, Bangladesh.
[3] Department of Botany, Jagannath University, Dhaka, Bangladesh.

MATERIALS AND METHOD

Seeds of three aromatic rice varieties namely Kalijira, Kataribhog and BR 34 Jira dhan were collected from Dinajpur district. Healthy seeds were tested by following standard seed health testing methods (Blotter method) for detecting and identifying seed-borne fungi. Two hundred seeds were incubated for each variety. Seeds were also sown in experimental field in the Botanic Garden of Dhaka University. Infected samples were collected from the field starting from maximum tillering stage to grain-filling stage of plant growth. After maximum tillering stage three fungal diseases were recorded on stems and sheaths.

The samples were collected during 29 March, 2009 to 30 December, 2009. Twenty five samples were examined from healthy and infected stem and sheaths of each variety. In case of grain 200 inocula were incubated for each rice variety. Healthy samples were isolated for control treatment whenever necessary.

Isolation of fungi: The fungi were isolated on Potato Dextrose Agar (PDA) medium following Tissue planting method (CAB 1968). Thirty inocula, each measuring 2 mm^2, were cut from a particular specimen and kept in a sterile Petri plate. The inocula were washed with sterile water and then surface sterilized by dipping in 10% Chlorox for 3 minutes. Then the inocula were transferred into a sterile Petri plate containing sterile blotting paper to remove the surface water. The surface sterilized inocula were used for isolation. Three inocula were placed in each plate and incubated for 5 - 7 days at 25 ± 1º C. Fungi growing from the inocula were transferred to separate plates and slants for further studies and storage. Percentage association of the fungi was recorded. Seed inocula were surface sterilized with 10% Chlorox for 5 minutes and isolated following Blotter method. Ten seeds were inoculated per plate.

Morphological studies: Detailed morphological studies of the fungal isolates were made. All the specimens included in the present study were preserved in the Herbarium, Mycology and Plant Pathology section, Department of Botany, University of Dhaka, Bangladesh. Identification of the isolates was determined following standared literatures (Booth 1971, Barnett and Hunter 2000, Ellis 1971, 1976, Sutton 1980).

RESULTS AND DISCUSSIONS

Sheath rot: Sheath rot is one of the major diseases of rice. The disease was first described by (Sawada 1922) from Taiwan. The causal organism is *Sarocladium oryzae* (Sawada) W. Gams and D. Hawksw. Kawamura (1940) studied pathogenicity and physiology of the pathogen. The rot occurs on the uppermost leaf sheaths enclosing the young panicles. The lesions start as oblong or somewhat irregular spots, 0.5 - 1.5 cm long, with brown margins and grey centers or they may be greyish brown throughout.

They enlarge and often coalesce and may cover most of the leaf sheath. The young panicles remain within the sheath or only partially emerge. An abundant whitish powdery growth may be found inside affected sheaths and young panicles are rotted. The fungus also caused browning of grains and the inner surface of the leaf sheath which looked normal from the outside in the field. Miah *et al*. (1985) first reported sheath rot from Bangledesh. Shamsi (1999) examined 794 sheath rot affected rice samples from 317 varieties/lines collected from all over Bangladesh. Her findings established that along with *Sarocladium oryzae*, *Curvularia lunata* (Wakker) Boedijn, *Drechslera oryzae* (Breda de Hann) Subram and Jain and *Nigrospora oryzae* (Berk. Br.) Petch causes sheath rot type symptoms on various rice varieties. She also reported that crop losses measured on single hill basis, 90 - 100% yield losses may be encountered under natural field conditions due to sheath rot infection when the disease severity ranges between 6 to 9 scale.

In the present experiment four fungal species were isolated from dried seeds of Kalijira. The isolated fungi were *Aspergillus* sp., *Cladosporium* sp., *Colletotrichum* sp. and *Sarocladium oryzae.* Three fungal species i.e. *Aspergillus* sp. *Curvularia* sp., and *Sarocladium oryzae* were isolated from Kataribhog and one species *Aspergillus* sp. was isolated from BR34 Jira dhan. Association of *Sarocladium oryzae* was higher (6%) in Kataribhog and association of other fungi was 2%. Presence of *Colletotrichum* sp. with rice was first reported by Pitt *et al.* from Thailand (1994). This is the first report of association of *Colletotrichum* sp. with rice plant from Bangladesh (Table 1 and Plate 2 A-D).

Table 1. Frequency (%) of association of fungi with dry and wet seeds of three aromatic rice varieties.

Name of fungi	Rice varieties					
	Kalijira		Kataribhog		BR 34 Jira dhan	
	DS	WS	DS	WS	DS	WS
Aspergillus sp.	2.0	2.0	2.0	2.0	20.	–
Cladosporium sp.	2.0	–	–	20	–	–
Colletotrichum sp.	2.0	6.0	–	–	–	6.0
Curvularia sp.	–	6.0	2.0	4.0	–	6.0
Sarocladium oryzae	2.0	18.0	6.0	17.0	–	14.0

– = No isolate, DS = Dry seed, WS = Wet seed.

Five fungal species were isolated from wet seeds of three aromatic rice varieties and frequency percentage of these fungi was higher than dry seeds. Due to lack of moisture fungi did not grow properly on dry seed, on the other hand fungi easily grow on wet seed due to adequate moisture. The isolated fungi were *Aspergillus* sp., *Cladosporium* sp., *Colletotrichum* sp., *Curvularia* sp. and *Sarocladium oryzae. Curvularia* sp. and *S. oryzae* were isolated from all the three rice varieties. Frequency percentage of *S. oryzae* was

highest in Kalijira (18%) and lowest (14%) in BR 34 Jira dhan (Table 1). The isolated fungi sporulated well on PDA medium.

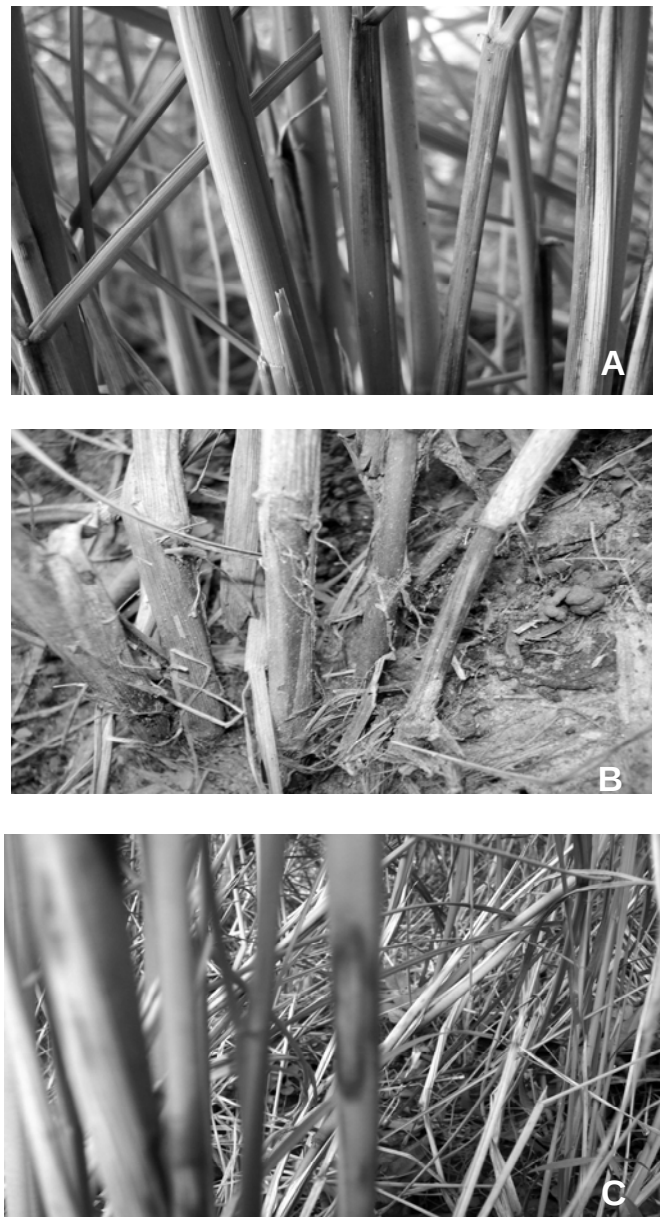

Plate 1. Photographs showing: A. Sheath rot, B. Stem rot, and C. Sheath blotch disease symptoms on aromatic rice varieties.

When the plants attained maximum tillering to boot stage sheath rot symptom developed on all the three varieties. Frequency percentage of tiller infection was highest (78%) in BR 34 Jira dhan and lowest (45%) in Kataribhog (Table 2). At the grain filling stage frequency percentage of association of *S. oryzae* was highest (67 %) in BR 34 Jira dhan and lowest (20%) in Kalijira (Table 3).

Table 2. Frequency (%) of infected tiller showing symptoms on three aromatic rice varieties at grain filling stage.

Symptom	Rice varieties with tiller infection (%)		
	Kalijira	Kataribhog	BR 34 Jira dhan
Sheath rot	78	45	67
Stem rot	57	–	–
Sheath blotch	–	30	–

Ten tillers were examined per variety per replication.

Among the three rice varieties Kalijira was severely infected by sheath rot and 78% tillers were affected. Tiller infection percentage was 45 and 67 in case of Kataribhog and BR 34 Jira dhan respectively. In Kalijira 57% tillers showed stem rot symptom. Sheath blotch was recorded on Kataribhog and 30% tillers were affected. From the sample study total eight fungal species were found associated with three aromatic rice varieties. The associated fungi were *Aspergillus niger*, *Aspergillus* sp., *Fusarium* sp. (only microconidia), *Curvularia* sp., *Nigrospora oryzae*, *Sarocladium oryzae*, *Sclerotium oryzae* and *Pyrenochaeta oryzae* (Table 3, Plate 1 A-C and Plate 2 D – I).

Table 3. Frequency (%) of association of fungi with three aromatic rice varieties.

Name of fungi	Rice varietes					
	Kalijira		Kataribhog		BR 34 Jira dhan	
Symptom	Healthy	Diseased	Healthy	Diseased	Healthy	Diseased
Sheath rot						
Aspergillus niger	0	7	4	27	20	14
Aspergillus sp.	–	27	24	12	2	14
Fusarium sp.	10	20	–	3	–	–
Curvularia sp.	–	–	–	24	4	14
Nigrospora oryzae	–	2.0	–	–	–	–
Sarocladium oryzae	12	20	–	–	–	67
Stem rot						
Sclerotium oryzae	–	54	–	3	–	–
Sheath blotch						
Pyrenochaeta oryzae	–	4	–	–	–	–

– = No isolate.

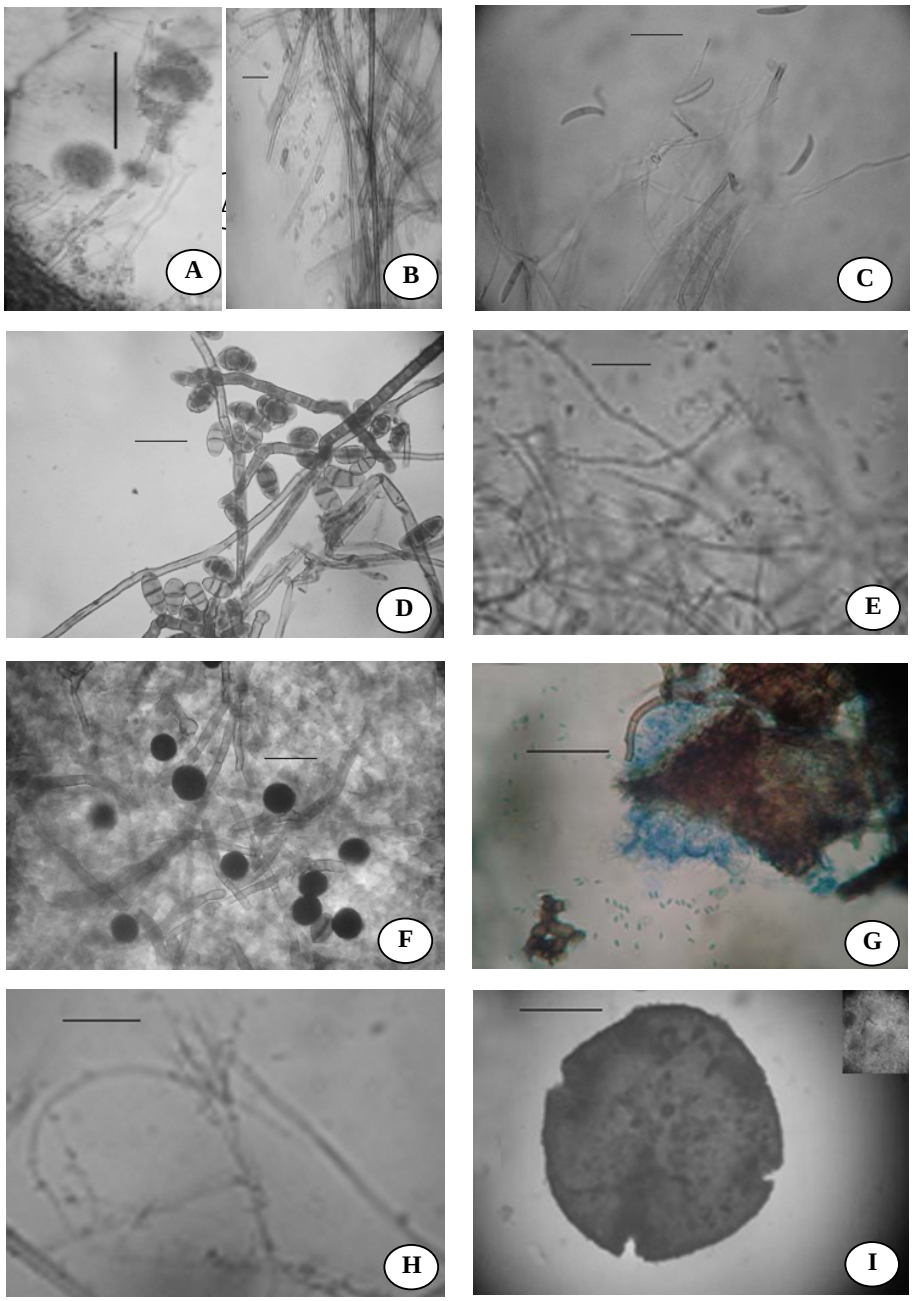

Plate 2. Photomicrograph of fungi : A. *Aspergillus* sp., B. *Cladosporium* sp., C. *Colletotrichum* sp., D. *Curvularia* sp., E. *Fusarium* sp., F. *Nigrospora oryzae*, G. *Pyrenochaeta oryzae*, H. *Sarocladium oryzae*, I. *Sclerotium oryzae*. (Bar = 50 μm).

Stem rot: The stem rot of rice disease is caused by *Sclerotium oryzae* Catt. The disease usually begins to appear in the field during the later stages of growth of the rice plants. It starts with a small, blackish, irregular lesion on the outer leaf sheath near the water line. Sometimes the sclerotium which initiated the lesion may at this stage still be attached to the affected part. The lesion enlarges as the disease progresses, the fungus penetrates into the inner leaf sheath, and finally the leaf sheath partially or entirely rot. Numerous appressoria or patches of infection cushions are formed on the culm. Brownish-black lesions appear and finally one or two internodes of the stem rot and collapse and such infected stems lodge. On splitting infected internodes, dark greyish mycelium may be found within the hollow stem and small black sclerotia can be seen dotted all over the inner surface. However, the next lower internode may be completely free from any sign of the organism. The sclerotia are also found on infected leaf sheaths. The presence of the characteristic sclerotia is usually a positive and easy way of diagnosing the disease (Ou 1985).

Stem rot is one of the major diseases of rice. A survey conducted during 1979 - ‘81 in Bangladesh revealed 20 rice diseases and stem rot was studied methodically during this period (Miah *et al.* 1985). In the present study stem rot was recorded on Kalijira at the ground level of tillers and 57% tillers were infected due to the disease. Frequency of association of *Sclerotium oryzae* was 54%. The pathogen frequently forms sclerotia on PDA medium (Tables 2, 3).

Sheath blotch: Sheath blotch caused by *Pyrenochaeta oryzae* Shirai *ex* Miyake, was first observed in Japan in 1910. It has since been reported from Myanmar, China, India, Malaysia and Sierra Leone and is also present in the Philippines and Thailand. It usually attacks the leaf sheath but occasionally also the leaf blade and glumes. The blotches are oblong, about one inch long and brownish at first and gradually the centre becomes grey or greyish brown and is dotted with the black fruiting bodies of the fungus. The margin remains brown. Sheath blotch is a minor disease of rice and inadequate information is available on this. In the present study sheath blotch was recorded on Kataribhog. Frequency percentage of tiller infection was 30. Frequency percentage of association of the fungus was also recorded (Tables 2, 3). The fungus did not sporulate on PDA medium.

CONCLUSION

Present research work indicates that three aromatic rice varieties, namely Kalijira, Kataribhog and BR 34 Jira dhan are highly susceptible to sheath rot. Another important finding of this experiment is association of *Colletotrichum* sp. with aromatic rice varieties which is a new addition in the field of Plant Pathology.

REFERENCES

Ashrafuzzaman, M., M. R. Islam, M. R. Ismail, S. M. Shahidullah and M. M. Hanafi, 2009. Evaluation of six aromatic rice varieties for yield and yield contributing characters. *Int. J. Agri. Biol*. **11**: 616- 620.

Barnett, H. L. and B. Hunter. 2000. *Illustrated Genera of Imperfect Fungi*. 4th edn., Burgessbub. Co. Minneapolis. pp.185.

Booth, C. 1971. *The Genus Fusarium*. The Commonwealth Mycological Institute. England. pp.273.

CAB (Commonwealth Agricultural Bureau) 1968. *Plant Pathologist's Pocket Book.* The Commonwealth Mycological Institute, England, pp. 1-267.

Dutta, R. K., M. A. Baset Mia and S. Khanam, 2002. Plant agriculture and growth characteristics of fine grain and aromatic rices and their relation with grain yield. *Newslett.* **51**: 51- 56.

Ellis, M. B. 1971. *Dematiaceous Hyphomycetes.* The Commonwealth Mycological Institute, England, pp. 608

Ellis, M. B. 1976. *More Dematiaceous Hyphomycete*s. The Commonwealth Mycological Institute, England, pp. 507

Kawamura, E. 1940. Notes on the sheath rot of rice plant with special reference to its causal organism *Acrocylindrium oryzae Saw*. *Ann. Phytopathol. Soc. Japan.* **10**: 55-60. (Japanese)

Miah, S.A., A.K.M Shahjahan, M.A. Hossain and M.M Sharma. 1985. Survey of rice diseases in Bangladesh. *Tropical Pest Management.* **31**(3): 204-213.

Miyake, I. 1910. Studien über die Pilze der Reispflanze in Japan. College of Agric. Imperial Univ. Tokyo **2**: 237-276.

Ou, S.H, 1985. *Rice Diseases*. Commonwealth Mycological Institute, England pp. 380.

Pitt, J. I., A. D. Hocking, K. Bhudhasamai, B. F. Miscamble, K. A. Wheeler and P. Tarboon 1994. The normal mycoflora of commodities from Thailand.2. Beens, rice, small grain and other commodities. *Int. J. of Food Microb*. **23**(1): 35-53.

Probhakaran, J., V. Ragunathan and N. N. Prasad. 1973. Occurrence of sheath rot disease of rice caused by *Acrocylindrium oryzae*. *Annamalai Univ. Agric. Res. Annual* **4/5** : 182-183.

Sarker, M. A. H. 2002. Indigenous fine aromatic rice production: Bangladesh perspective. Development of basic standard for organic rice cultivation. RDA (Rural Development Administration) and Dankook Univ. Korea. pp. 1-9.

Sawada, K. 1922. *Descriptive catalogue of Formosan fungi II*. Rep. Govt. Res. Inst. Dep. Agric. Formosa. **2**: 135.

Shakeel, A., A. Hussain, H. Ali and A. Ahmad. 2005. Transplanted fine rice (*Oryza sativa* L.) Productivity as affected by plant density and irrigation regimes. *Int. J. Agric. Biol.* **7:** 445-447.

Shamsi, S. 1999. *Investigations into the sheath rot disease of rice (Oryza sativa L.) in Bangladesh.* Ph.D. Thesis. Department of Botany, University of Dhaka. pp. i-xii + 1-127.

Sutton, B.C. 1980. *The Coelomycetes. Fungi Imperfecti with Pycnidia, Acervuli and Stroma*. Commonwealth Mycological Institute, England. pp. 696.

(*Received revised manuscript on 28 June, 2010*)