Sheath Blotch of Rice: A Disease New to the Americas

L. E. DATNOFF, Assistant Professor of Plant Pathology, and D. B. JONES, Associate Professor of Agronomy, Everglades Research and Education Center, University of Florida–IFAS, P.O. Box 8003, Belle Glade 33430

ABSTRACT

Datnoff, L. E., and Jones, D. B. 1992. Sheath blotch of rice: A disease new to the Americas. Plant Dis. 76:1182-1184.

Symptoms of sheath blotch were observed on rice plants grown in southern Florida. A fungus was isolated from infected tissue and identified as *Pyrenochaeta oryzae*. This pathogen was not previously known to occur in the Americas. Sheaths inoculated with the pathogen developed reddish brown to brown lesions within 5–15 days. *P. oryzae* was reisolated from inoculated tissue. Sizes of pycnidia, setae, and conidia for the isolates found in Florida and for herbarium specimens obtained from the National Fungus Collection were within the range described by other researchers. All commercial rice cultivars were susceptible to sheath blotch. This is the first decisive demonstration that *P. oryzae* is a pathogen of rice in the Americas.

Additional keywords: *Oryza sativa*

During the summer of 1991, symptoms of sheath blotch were observed on rice (*Oryza sativa* L.) growing in the Everglades Agricultural Area of southern Florida. These symptoms were large reddish brown to brown blotches on leaf sheaths.

Lesions of this disease generally start from the margin of a sheath as dark reddish brown, oblong blotches that enlarge, become bluish gray, and may cover the entire sheath (11,13) (Fig. 1). Lesions may grow to 10 cm and often appear at the junction of sheath and leaf blade, just below the leaf collar, without causing the collar to break. When dry, the affected part of the sheath turns gray-brown, with or without distinct red-brown to brown margins. Many pycnidia occur within the blotch.

Sheath blotch is caused by *Pyrenochaeta oryzae* Shirai ex Miyake (9). It was first observed in Japan in 1910 and was referred to as *Yosho-kappanbyo* (sheath brown spot) (6,7). This disease usually attacks the leaf sheath but can occasionally affect the leaf blade and glumes (11,13).

In the United States, *P. oryzae* was reported in Arkansas in 1931 (1). In addition, a herbarium specimen of *P. oryzae* in the National Fungus Collections, BPI US0361891, was collected in Texas in 1934. However, there are no published reports demonstrating pathogenicity, nor are there additional reports of the disease from any other U.S. rice-growing region. In Atkins's extensive literature review of rice diseases in the Americas (2), several fungi that have been reported to occur on rice were not included, because their pathogenicity was very doubtful. Evidently, *P. oryzae* was included in this group.

The Commonwealth Mycological Institute does not include the Americas within the known geographical range for this pathogen (13). According to their records, *P. oryzae* has been reported only from Africa (Sierra Leone and Swaziland), Asia (Burma, China, India, Japan, Malaysia, Sri Lanka, Philippines, and Thailand), Australia, and Oceania (Fiji and Solomon Islands) (8,13). More recently, it was reported from Bangladesh (14).

This research sought to confirm the identity of the pathogen causing sheath blotch in Florida, to demonstrate its

Florida Agricultural Experiment Station Journal Series R-02296

Accepted for publication 5 June 1992.

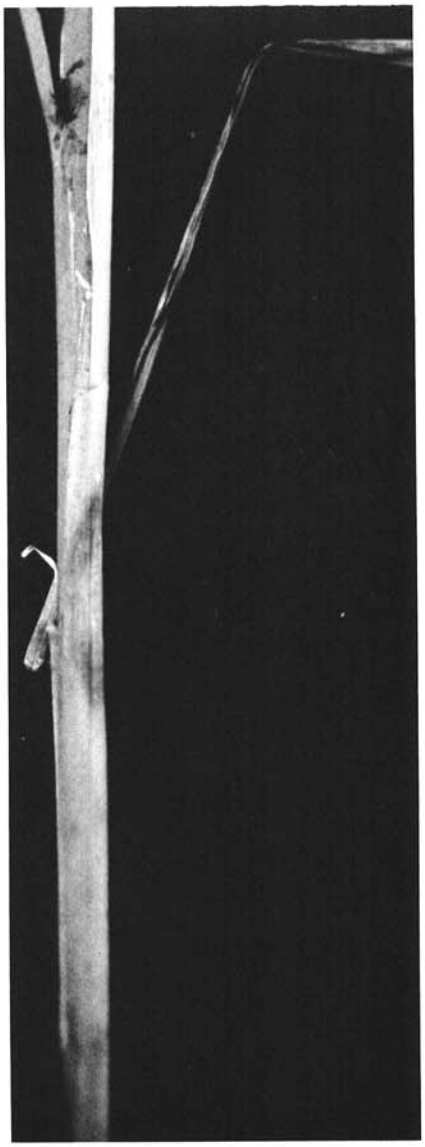

Fig. 1. Oblong enlarged blotch caused by *Pyrenochaeta oryzae* on rice leaf sheath.

pathogenicity, and to measure the susceptibility of commercially grown rice cultivars under field conditions. A preliminary report has been published (4).

MATERIALS AND METHODS

Laboratory studies. Fifteen samples of infected rice leaf sheaths (cultivar Lemont) were collected from the Everglades Research and Education Center and from several commercial rice fields in the Everglades Agricultural Area during 1991. Using the following procedures of Datnoff et al (5), several isolates of *P. oryzae* were established from pycnidia associated with infected plants. Pycnidia were placed in drops of sterile distilled water. A single drop of water containing oozing pycnidia was smeared over a 9-cm-diameter water agar (Difco Bacto agar) culture amended with 100 μg of streptomycin sulfate. After 14 hr, germinating single spores were transferred to the same medium and placed in an incubator at 25 C. Pycnidia developed and produced conidia after 25–30 days.

Table 1. Herbarium specimens of *Pyrenochaeta oryzae*

Location	Collector	Determinator	Collection number	Date (origin of sample)
Stuttgart, Arkansas	E. Tullis	E. Tullis	US0361883	Fall 1931
San Francisco, California	K. Swim	S. Waite	US0361884	Apr. 1982 (China)
Los Angeles, California	F. Thomas	R. Hashimoto	US0361885	Feb. 1982 (Hong Kong)
Los Angeles, California	V. Johnson	A. Rossman	US0361886	Nov. 1982 (Korea?)
San Francisco, California	A. Lopez	S. Waite	US0361887	Feb. 1981 (China)
Los Banos, Philippines	G. Ocfemia	S. Satin	US0361888	Jan. 1918
Philippines (city unknown)	O. Reinking	S. Stevenson	US0361889	Nov. 1922
Seattle, Washington	W. Wheeler	A. Jenkins	US0361890	May 1941 (Japan)
Seattle, Washington	R. Wilbur	W. Diehl	US0361890	May 1941 (Japan)
Beaumont, Texas	E. Tullis	E. Tullis	US0361891	(?) 1934

Table 2. Incidence of naturally occurring sheath blotch for 13 rice cultivars in southern Florida in 1991

Cultivar	Disease incidence (%)[a]
Guichow	32
Jasmine	24
Lacassine	24
Newbonnet	20
Katy	18
Cypress	18
Lemont	18
Bengal	18
Rico	18
Lebonnet	16
Mercury	16
Gulfmont	14
Mars	10

[a] Analysis of sheath blotch incidence was conducted using arcsine-transformed data. Significant differences in disease incidence were not observed among cultivars.

Leaf sheaths of 10 Lemont rice seedlings, 30 days old, were inoculated either by atomizing or injecting them with an aqueous suspension of 1×10^6 conidia per milliliter or by placing an agar plug containing mycelia directly onto the sheath or leaf. Uninoculated seedlings or seedlings injected with sterile distilled water served as controls. Inoculated and uninoculated seedlings in 30-cm pots were covered separately with plastic bags for 48 hr on a laboratory bench at 25 C or placed in an incubator at 29 C under a 12-hr photoperiod of fluorescent light.

Herbarium specimens of *P. oryzae* were obtained from the USDA-ARS, National Fungus Collections-BPI, Beltsville, MD (Table 1). US0361883 was collected in Arkansas in 1931, and US0361891 was collected in Texas in 1934. Specimens US0361888 and US0-261889 were collected in the Philippines in 1918 and 1922, respectively. The others were interceptions from China, Hong Kong, Japan, and Korea at different ports of entry in California and Washington. These materials were used for comparison with sizes of pycnidia and conidia produced in culture or from infected tissue. All materials were mounted in sterile distilled water for comparison. Setae from Florida isolates could not be directly compared with the herbarium material, because many of the setae of the latter were not entirely intact. The size of conidia from seven Florida isolates ($n = 100$) was recorded. The diameter of pycnidia and length and width of setae were based upon the ranges of 45 and seven Florida isolates ($n = 50$), respectively.

Field studies. Thirteen cultivars were planted in a randomized complete block design with five replications at the Everglades Research and Education Center, Belle Glade, in 1991 (Table 2). Plots consisted of six rows, 6 m long and 20 cm apart. Seed was drill-seeded at a rate of 100 kg/ha. After planting (4–6 wk), when tillering plants, growth stage 3 (15), reached a height of approximately 15 cm, plots were flooded and remained flooded until maturity. During growth stage 7 (milk stage) (15), naturally occurring sheath blotch incidence was recorded on 10 plants per experimental unit. Symptomatic tissue was randomly collected to determine presence of the pathogen.

RESULTS AND DISCUSSION

From the laboratory studies, 5–15 days after inoculation, sheaths and leaves developed reddish brown to brown, circular to irregular lesions typical of the disease. Some infected sheaths contained pycnidia developing directly in lesions, but many pycnidia were also observed on healthy tissue surrounding the lesion. Pycnidia were reisolated in pure culture. Sheath blotch symptoms did not develop on control plants. Thus, this is the first decisive demonstration that *P. oryzae* is a pathogen of rice in the Americas.

Sizes of pycnidia, setae, and biguttulate conidia for the herbarium specimens and the isolates found in Florida were within the range described by other researchers (Table 3). Mori et al (10) thought their fungus differed slightly from *P. oryzae* in size of pycnidia; however, setae and conidial measurements fell within Miyake's reported range.

Miyake (9) only reported a single diameter of 200 μm for *P. oryzae*. On the basis of his original description, it would be difficult to know the extent of variability in pycnidial diameter. In this study and in that of Mathur et al (8), the ranges for pycnidial diameter were

Table 3. Variation in diameter of pycnidia, length and width of pycnidial setae, and length and width of conidia reported for *Pyrenochaeta oryzae*

Source (reference)	Measurements (μm)				
	Pycnidia diameter	Setae		Conidia	
		Length	Width	Length	Width
Miyake (9)	200	60–140	4.0–5.0	4.0–6.0	1.5–2.0
Mathur et al (8)	120–300	66–132	4.4–6.5	4.0–6.5	1.5–2.0
Mori et al (10)	69–176	60–140	4.0–5.0	2.5–5.4	1.2–2.7
Padwick (12)	109–205	180	NL[a]	3.4–4.8	1.4
US0361883[b]	103–202	...[c]	...	3.6–5.4	1.8–3.6
US0361891[b]	108–225	...	...	3.6–5.4	1.8–3.6
Datnoff and Jones[d]	72–252	45–315	4.5–6.8	2.7–5.4	0.9–3.6

[a] Not listed.
[b] Pycnidia diameter and conidial lengths and widths, based on five pycnidial isolates and 40 conidia, respectively.
[c] Data not included.
[d] Diameter of pycnidia based upon the range of 45 isolates. Setae and conidial lengths and widths based upon the range of 50 setae from seven pycnidial isolates and 100 conidia from three pycnidial isolates.

very extensive, either 100 μm greater or about 130 μm smaller than that reported by Miyake. In addition, Mori et al (10) reported ranges that fell below Miyake's original description. These differences in pycnidial diameter might represent the inherent variability within the fungus and the effects of temperature, growth medium, and host.

Another species of *Pyrenochaeta, P. nipponica* Hara, has also been found to infect rice leaves; however, it has smaller pycnidia, setae, and conidia than *P. oryzae* (6,7). In addition, conidia are nonguttulate.

From the field study, all rice cultivars were susceptible to a natural epidemic of sheath blotch (Table 2), and only *P. oryzae* was recovered from infected tissue. Sheath blotch incidence ranged from 10% for cv. Mars to 32% for cv. Guichow.

Although Punithalingam (13) stated that this disease was considered to be of minor importance, Bhan and Ahuja (3) recently screened rice germ plasm for resistance. This suggests that the pathogen may be adversely affecting rice production in India. This disease was previously observed to be impacting rice production near Amritsar, India (M. C. Rush, *personal communication*). Whether this disease may or may not impact on rice production in Florida is not known at this time. Given that many of the more popular rice cultivars grown in the United States are susceptible, the disease warrants further study.

ACKNOWLEDGMENTS

We thank L. M. Carris for her helpful discussions on fungal taxonomy and J. Carroll, M. Robins, S. Venugopal, and A. Wilson for their excellent technical assistance.

LITERATURE CITED

1. Anonymous. 1960. Index of Plant Diseases in the United States. U.S. Dep. Agric. Agric. Handb. 165. 531 pp.
2. Atkins, J. G. 1974. Rice Diseases of the Americas: A Review of Literature. U.S. Dep. Agric. Agric. Handb. 448. 106 pp.
3. Bhan, U., and Ahuja, S.C. 1990. A disease rating scale for screening rice genotypes for resistance to sheath blotch. Int. Rice Res. Newsl. 15:9-10.
4. Datnoff, L. E., and Jones, D. B. Observations on rice sheath blotch in Florida. Proc. Rice Technol. Work. Group, 24th. (In press.)
5. Datnoff, L. E., Levy, C., Naik, D. M., and Sinclair, J. B. 1986. *Dactuliophora glycines*, a sclerotial state of *Pyrenochaeta glycines*. Trans. Br. Mycol. Soc. 87:297-301.
6. Hara, K. 1918. Diseases of the Rice Plant. Agricultural Society of Shizuoka, Tokyo, Japan. 170 pp.
7. Hashioka, Y. 1972. Rice diseases in the world. IX. Diseases due to Sphaeropsidales, fungi imperfecti (Fungal diseases 6). Riso 21:11-19.
8. Mathur, R. S., Chauhan, L. S., and Verma, S. C. 1963. *Pyrenochaeta oryzae* Shirai ex Miyake on *Oryzae sativa* L.—A new record for India. Curr. Sci. 32:312.
9. Miyake, I. 1910. Studien über die Pilze der Reispflanze in Japan. J. Coll. Agric. Tokyo Imp. Univ. 2:237-276.
10. Mori, K., Makino, A., and Osawa, T. 1963. A sheath brown spot due to *Pyrenochaeta* sp. Ann. Phytopathol. Soc. Jpn. 28:296.
11. Ou, S. H. 1985. Rice Diseases. 2nd ed. Commonwealth Mycological Institute, Kew, England. 380 pp.
12. Padwick, W. 1950. Manual of Rice Diseases. Commonwealth Mycological Institute, Kew, England. 198 pp.
13. Punithalingam, E. 1980. *Pyrenochaeta oryzae*. No. 666 in: Descriptions of Pathogenic Fungi and Bacteria. Commonw. Mycol. Inst., Kew, England.
14. Shahjahan, A. K. M., Ahmed, H. U., and Miah, S. 1983. Sheath blotch of rice in Bangladesh. Int. Rice Res. Newsl. 8:12.
15. Standard Evaluation System for Rice. 1980. International Rice Testing Program. 2nd ed. International Rice Research Institute, Los Banos, Philippines.