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A Survey of Rice Seed-borne Fungi in Taiwan

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ABSTRACT

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Fifty-five rice samples were collected from several seed lots obtained from major rice growing areas in Taiwan for this study. Twenty-five different fungi were found on these seeds by means of blotter and deep-freezing blotter methods. Among those, *Ascochyta oryzae, Acremoniella atra, Alternaria tenuis, Curvularia affinis, C. brachyspora, C. clavata, C. pallescens, Diplodia oryzae, Drechslera halodes, D. poae, D. rostrata, Fusarium lateritium, F. semitectum, Rhynchosporium oryzae,* and *Trichoconis padwickii* were isolated from rice for the first time in Taiwan. *Phoma glumarum* and *R. oryzae* occurred more on rice seed harvested from northern and eastern Taiwan than central and southern Taiwan. *Curvularia lunata* and *T. padwickii* occurred more on rice seed harvested from central and southern than from northern and eastern Taiwan.

Key words: rice, seed-borne fungi, rice pathogens, rice disease.

INTRODUCTION

Rice (*Oryza sativa* Linn.) is one of the most important food crops in the world, but has many diseases as the other major field crops. Diseases are usually important when crops are cultivated intensively in a large acreage, especially in developing areas or countries. Seventy one different of diseases rice are known to be transmitted through seed (11,12,13). Although 78 different diseases have been reported in Taiwan (2), rice seed health has not been thoroughly investigated before (17). Among rice diseases, many important fungal pathogens can be transmitted from seeds. To reduce the possiblility of distributing seed-borne pathogens, sowing healthy seed is necessary. The major purpose of this study was to investigate seed-borne fungal pathogens of two rice cultivars, *i.e.* Tainon 67 and Tainon 70, which were predominantly cultivated in Taiwan in recent years.

MATERIALS AND METHODS

Fifty-five seed samples were collected from major rice growing areas, and all were intended for sowing in Taiwan. Among these samples, 12 seed samples were collected from northern, 16 from central, 17 from southern, and 10 from eastern Taiwan. All seeds were harvested in October or November, 1986 and 1987.

Blotter and deep-freezing blotter methods were used to test every sample (9). Four hundred seeds of each sample were randomly selected and tested. Seeds were incubated in 25 C with diurnal light (12/12 hr, light/dark).

Seed-borne fungi were isolated and cultured on different media for sporulation. Potato-dextrose agar (PDA) was used for culturing *Alternaria tenuis* (C. G. Nees), *Ascochyta oryzae* (Cattaneo), *Curvularia lunata* ((Wakk.) Boedijn), *Phoma glumarum* (Ell. et Jracy.), *Pyrenochaeta oryzae* (Shirai), and *Nigrospora oryzae* (Berk. & Br.). Sterilized rice leaves were used to induce sporulation of *Drechslera oryzae* (Subram. & Jain), *D. halodes* (Subram. & Jain) and *D. rostrata* (Richardson & Fraser); rice agar (200 g dehulled rice, 20 g agar, 1 L dist. water) for *Rhynchosporium oryzae* (Hashioka & Yokogi); and Sach's medium for *Trichoconiella padwickii* (Ganguly). Spore suspensions (approx. 10^5 spores/ml) of each fungus were prepared and atomized onto 10 rice plants at seedling, tillering and heading stages. The inoculated plants were kept in a mist room (98% relative humidity) with 32 C for three days. Pathogenicity of isolated fungi was determined by fulfilling Koch's postulates.

RESULTS

Among the twenty five different fungi detected from rice seeds, 20 fungi were found on Tainon 67

(Table 1) and 24 fungi were occurred on Tainon 70 (Table 2). *Acrocylindrium oryzae* infected more seeds of Tainon 70 than Tainon 67. *Alternaria tenuis, Curvularia lunata, Nigrospora oryzae* and *Phoma glumarum* were the most common field fungi. The recovery of *N. oryzae* did not differ among seed samples. *Phoma glumarum* and *Rhynchosporium oryzae* occurred more frequently on seeds which were harvested from northern Taiwan than the southern areas, whereas the prevalence of *C. lunata* and *Trichoconis padwickii* were reversed. *A. tenuis* existed more on seeds harvested from central Taiwan than from other parts of Taiwan. There was no impressive differences in efficacy between blotter and deep-freezing blotter methods to detect rice seed-borne fungi.

Ascochyta oryzae, Acremoniella atra, Alternaria tenuis, Curvularia affinis, C. brachyspora, C. clavata, C. pallescens, Diplodia oryzae, Drechslera halodes, D. poae, D. rostrata, Fusarium lateritium, F. semitectum, Rhynchosporium oryzae, and *Trichoconis padwickii* are new records on rice in Taiwan. *A. oryzae, D. halodes, D. rostrata, R. oryzae,* and *T. padwickii* infected rice plants, while *A. atra, A. tenuis,* and *C. lunata* did not. *A. oryzae* caused tiny brown lesions on inoculated leaf blade. The infected leaf tuned to yellowing or marginal necrosis. Brown lesions were appeared on leaf after 3 days of inoculating *D. halodes. D. rostrata* also caused small, oval, brown spots on rice, but symptom appeared 7 days after inoculation. *R. oryzae* initiated leaf scald usually on mature leaves. The characteristic of leaf scald was zonated lesions encircled by dark brown bands and usually developed at leaf tips. *T. padwickii* did not infect rice seedling and mature plant readily. However, rice kernel was easy to be infected and turned to kernel spot, discoloration and shrivelling.

DISCUSSION

Rice is the most important crop grown in Taiwan. Local rice pathologists primarily focused their attention to diseases on growing plants. Since some seed-borne fungi may be seed-transmitted pathogens, the information on rice seed health is a fundamental and necessary requirement to provide to growers, breeders, and government. In this study, 15 different fungi were reported for the first time on rice seeds. These fungi were identified based on several reference books (1,4,5,9,10). Among them, *A. oryzae, C. brachyspora, C. clavata, D. halodes,* and *D. poae* were not listed in "An annotated list of seed-borne diseases" (11,12,13). *Ascochyta oryzae* and *D. halodes* were demonstrated as

TABLE 1. Seed-borne fungi isolated from rice seeds of Tainon 67 harvested from different areas of Taiwan

Fungus	% of infested/infected seeds[1]			
	N[2]	C	S	E
Acremoniella atra	0.25/ 1.75[3]	0.25/ 0.25	1.25/ 0.75	0.00/ 0.00
Acrocylindrium oryzae	1.75/ 0.75	1.00/ 0.75	2.25/ 3.50	0.00/ 0.00
Alternaria tenuis	4.25/ 8.75	58.00/54.50	13.25/23.75	0.00/ 0.00
Cladosporium spp.	8.75/11.00	9.25/13.75	1.75/ 8.25	2.50/ 5.50
Curvularia affinis	0.00/ 0.25	0.00/ 0.00	0.00/ 0.00	0.00/ 0.00
C. clavata	0.00/ 0.25	0.00/ 0.00	0.00/ 0.00	0.00/ 0.25
C. lunata	14.50/10.25	39.50/38.50	51.75/46.25	1.50/ 1.00
C. pallescens	0.00/ 0.00	0.00/ 0.00	0.50/ 0.50	0.00/ 0.00
Drechslera halodes	1.00/ 0.00	0.00/ 0.00	0.00/ 1.00	0.00/ 0.00
D. oryzae	1.00/ 1.25	13.00/11.75	10.00/ 6.50	2.75/ 2.00
D. poae	0.00/ 0.00	1.00/ 0.00	0.00/ 0.00	0.00/ 0.00
D. rostrata	0.00/ 0.00	0.50/ 1.00	1.50/ 0.25	0.00/ 0.00
Fusarium lateritium	12.50/16.00	1.00/ 1.25	4.00/ 1.75	2.00/ 1.00
F. moniliforme	0.00/ 0.00	0.00/ 0.00	0.00/ 0.00	0.75/ 3.50
F. semitectum	9.00/ 9.75	6.25/20.75	12.25/13.00	2.00/ 6.75
Nigrospora oryzae	41.00/38.75	65.00/66.00	40.25/35.00	42.25/30.75
Phoma glumarum	55.50/56.25	23.50/21.25	4.00/ 8.00	39.25/36.00
Rhynchosporium oryzae	2.25/ 1.75	0.00/ 1.00	0.75/ 0.25	7.50/ 4.50
Trematospharella elongata	0.25/ 0.25	1.25/ 0.25	0.75/ 0.50	0.00/ 0.00
Trichoconis padwickii	0.75/ 1.00	0.25/ 0.25	6.50/ 6.50	0.00/ 0.00

[1] Twenty seven seed samples were tested. 400 seeds of each sample were randomly selected and tested.
[2] N: northern, C: central, S: southern, and E: eastern Taiwan.
[3] Data collected from blotter and deep-freezing blotter methods.

TABLE 2. Seed-borne fungi isolated from rice seeds of Tainon 70 harvested from different areas of Taiwan

Fungus	% of infested/infected seeds[1]			
	N[2]	C	S	E
Ascochyta oryzae	0.00/ 0.00[3]	0.00/ 0.00	0.00/ 0.25	0.00/ 0.00
Acremoniella atra	0.00/ 0.00	1.50/ 1.50	0.50/ 0.50	0.00/ 0.00
Acrocylindrium oryzae	9.50/13.50	17.75/14.50	8.00/13.50	8.75/12.75
Alternaria tenuis	9.75/13.50	31.75/32.25	9.75/16.25	1.00/ 1.50
Cladosporium spp.	0.50/ 2.50	23.05/24.50	4.00/ 7.00	0.00/ 0.00
Curvularia affinis	0.00/ 0.00	0.00/ 0.00	0.00/ 0.75	0.00/ 0.00
C. brachyspora	0.00/ 0.00	0.00/ 0.25	0.00/ 0.00	0.00/ 0.00
C. lunata	19.50/13.50	32.75/32.75	40.75/38.50	16.50/16.50
C. pallescens	0.50/ 0.50	0.00/ 1.50	0.25/ 0.25	0.00/ 0.00
Diplodia oryzae	0.00/ 0.00	0.00/ 0.00	3.00/ 2.75	0.00/ 0.00
Drechslera halodes	1.00/ 0.00	0.25/ 0.25	0.25/ 0.25	0.25/ 0.00
D. oryzae	0.00/ 0.00	1.00/ 0.00	0.25/ 0.00	0.00/ 0.00
D. poae	0.00/ 0.00	1.00/ 0.00	0.25/ 0.00	0.00/ 0.00
D. rostrata	0.50/ 0.50	0.00/ 0.25	0.50/ 0.25	0.75/ 0.25
Fusarium lateritium	0.00/ 1.00	7.75/ 4.50	1.50/ 3.50	0.75/ 0.62
F. moniliforme	0.00/ 0.00	0.00/ 0.00	0.00/ 0.25	0.16/ 0.00
F. semitectum	2.50/ 0.00	12.25/ 5.75	6.50/ 9.50	0.00/ 0.12
Nigrospora oryzae	48.50/61.50	58.50/56.50	49.90/47.25	5.75/ 3.62
Phoma glumarum	64.00/58.00	15.00/23.25	5.25/ 6.50	8.00/ 8.75
Pyrenochaeta oryzae	0.50/ 0.50	0.25/ 0.25	0.50/ 0.25	0.87/ 0.25
Pyricularia oryzae	0.00/ 0.00	0.00/ 0.00	0.00/ 0.00	0.00/ 0.25
Rhynchosporium oryzae	8.00/ 3.00	0.25/ 0.25	0.25/ 0.00	0.25/ 0.12
Trematospharella elongata	0.00/ 0.00	0.50/ 0.25	0.50/ 0.00	0.00/ 0.00
Trichoconis padwickii	0.50/ 1.00	0.50/ 3.00	3.50/ 4.75	0.18/ 0.25

[1] Twenty eight seed samples were tested. 400 seeds of each sample were randomly selected and tested.
[2] N: northern, C: central, S: southern, and E: eastern Taiwan.
[3] Data collected from blotter and deep-freezing blotter methods.

TABLE 3. The temperature and precipitation in different areas of Taiwan in October and November of 1986 and 1987

Weather Parameters	Year	Locations of Taiwan N[1]	C	S	E
Temperature (C)	1986	22.07[2]	23.10	25.30	23.45
	1987	23.53	24.05	26.40	25.10
Precipitation (mm)	1986	206.37	33.05	1.70	199.63
	1987	204.80	8.25	52.57	310.35
Time of precipitation (hr)	1986	142.82	18.15	3.37	60.70
	1987	104.67	15.25	31.20	59.08

[1] N: northern, C: central, S: southern, and E: eastern Taiwan.
[2] Data obtained from the Central Weather Bureau of the Republic of China in Taiwan.

rice pathogens in this study. *Pyrenochaeta oryzae* which was not previously recorded as a seed-borne pathogen that could inititate a disease was also detected in this study. *P. oryzae* is known to cause yellow blight and sheath blotch on rice (15). Although the appearance of *A. oryzae*, *D. halodes*, and *P. oryzae* was not frequent, the potential of these fungi to spread and cause disease can not be underestimated.

Rhynchosporium oryzae (7,8) and *T. padwickii* (6,16,18) were identified as seed-borne pathogens. However, the diseases caused by these two pathogens had not been reported in Taiwan before. This is possible since the occurrence of these diseases may not be common or their symptoms were mixed with those of other diseases, or these two pathogens were previously misidentified by local rice pathologists.

Phoma glumarum and *R. oryzae* were detected more on rice seeds were harvested from northernand eastern Taiwan, than from central and southern Taiwan. These pathogens may prefer to survive under lower temperatures and more wet conditions, since the temperature and amount of precipitation in northern and eastern Taiwan in October and November was lower and higher, respectively, than central and southern Taiwan (Table 3). The panicle was readily

infected by *P. glumarum* (10) and *R. oryzae* (3,14) when the weather was cool and wet during anthesis. On the contrary, *T. padwickii* and *C. lunata* occurred more in central and southern Taiwan than northern Taiwan. The possible reason may be these pathogens preferred high temperature more than their requirement for moisture. However, this speculation needed to be confirmed by further experiments.

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LITERATURE CITED

1. Agarwal, P. C., Mortensen, C. N., and Mathur, S. B. 1989. Seed-borne Diseases and Seed Health Testing of Rice. CAB, Phytopathological papers No. 30. 106 pp.
2. Anon. 1979. List of Plant Disease in Taiwan. 2nd., Plant Protection Society, Republic of China. 404 pp. (In chinese)
3. D'souza, T. F., and Venkataramanan, M. N. 1976. Note on the occurrence and distribution of leaf-scald disease of rice in Maharashtra. Indian J. Agr. Sci. 46:386-387.
4. Ellis, M. B. 1971. Dematiaceous Hyphomycetes. Common Wealth Mycological Institute, England. 608 pp.
5. Ellis, M. B. 1976. More Dematiaceous Hyphomycetes. Common Wealth Mycological Institute, England. 507 pp.
6. Gora, M. A., Prasad, Y., and Singh, B. N. 1987. Loss in rice seed weight due to *Trichoconiella padwickii*. Int. Rice Research Newsletter 12:28-29.
7. Kim, W. G., Park, J. S., and Yu, S. H. 1984. Seed infection and damage to rice seeds and seedlings by seed-borne *Gerlachia oryzae*. Korean J. Plant Prot. 23:126-131.
8. Mia, A. T., and Safeeulla, K. M. 1986. Transmission of *Gerlachia oryzae*, the leaf scald fungus of rice, from seed to seedling. Seed Research 14:111-114.
9. Neergaard, P. 1979. Seed Pathology vol. 1. London and Basingstoke, Macmillan Press, 839 pp.
10. Ou, S. H. 1972. Rice Diseases. Common Wealth Mycological Institute, Kew, Surrey, England. 368 pp.
11. Richardson, M. J. 1979. An Annotated List of Seed-Borne Diseases. Int. Seed Testing Assoc., Zurich, Switzerland. 320 pp.
12. Richardson, M. J. 1981. Supplement 1 to an Annotated List of Seed-Borne Disease. Int. Seed Testing Assoc., Zurich, Switzerland. 78 pp.
13. Richardson, M. J. 1983. Supplement 2 to an Annotated List of Seed-Borne Diseases. Int. Seed Testing Assoc., Zurich, Switzerland. 108 pp.
14. Schieber, E. 1962. Rhynchosporium leaf scald of rice in Guatemala. Plant Dis. Reptr. 46:202.
15. Shahjahan, A. K. M., Ahmed, H. U., and Miah, S. A. 1983. Sheath blotch of rice in Bangladesh. Int. Rice Research Newsletter. 8:12.
16. Swamy, S. K., and Urs, S. D. 1979. Occurrence of *Trichoconis padwickii* Ganguly on paddy in Karrataka. Current Research 10:170.
17. Wu, W. S., Gong, C. S., and Chen, C. C. 1972. Study on the relations between rice seed-borne microflora and chemical treatment. Phytopathologist and Entomologist (NTU) 2:152-163.
18. Zakeri, Z., and Zad, J. 1987. Seed-borne fungi associated with some abnormalities of rice seedlings. Iranian J. Plant Pathol. 23:19-27.

摘　　要

吳文希、杜小強．1993．臺灣水稻種媒眞菌之調查．植病會刊 2:52-55．(台北市　國立台灣大學植物病蟲害學系)

從台灣各重要水稻生產區域，收集到55個種子樣品，供作種子健康檢查；利用吸濕紙及冷凍吸濕紙法檢測，在此等樣品上共檢測出25種不同的眞菌，其中 *Ascochyta oryzae*, *Acremoniella atra*, *Alternaria tenuis*, *Curvularia affinis*, *C. brachyspora*, *C. clavata*, *C. pallescens*, *Diplodia oryzae*, *Drechslera halodes*, *D. poae*, *D. rostrata*, *Fusarium lateritium*, *F. semitectum*, *Rhynchosporium oryzae*, 及 *Trichoconis padwickii* 在本省是第一次從水稻種子上被分離出。種媒眞菌中，*Phoma glumarum* 及 *R. oryzae* 在從北部及東部所收穫的水稻種子上，比其他地區者多；而 *C. lunata* 及 *T. padwickii* 則在採收於中部及南部地區的水稻種子上，比採自於其他地區者多。

關鍵詞：水稻，種媒眞菌，水稻病原菌，水稻病害。