

PHYSIOLOGIC RACES OF *PELLICULARIA SASAKII* IN TAIWAN⁽¹⁾

by

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Sheath blight disease incited by *Pellicularia sasakii* on rice plants is of the second importance to blast in distribution as well as damage for the rice culture in Taiwan (Hashioka 1951). Under the present situation in Taiwan, the *japonica* type of rice is more susceptible. Yield loss from this disease is around 14-17% (Lo 1961). According to Lo (Personal communication), the loss due to the blast disease might have been exceeded by the sclerotial sheath blight which has become increasingly prevalent in recent years (Chiu 1962).

Sawada (1912) stated that the fungus might be able to infect a diverse number of plants, 47 species belonging to 4 families in Taiwan; 60 species belonging to 16 families in Japan. Matsumoto (1934) reported that there were 16 strains of the fungus collected in Taiwan from various hosts, including rice, sugarcane, groundnut, french bean, cowpea and camphor. Nakada and Kawamura (1939) pointed out that there were 16, 9 and 3 biotypes observed according to the cultural characteristics of the fungus on Czapek's, Potato sucrose and dried plum agar, respectively. They also stated that the suscepts attacked by this parasite were about 188 species of 32 families in Japan.

In consideration of the information stated above, one can presume the existence of many physiologic races of the fungus in nature. For this reason an attempt on studies of the feasible existence of different races in Taiwan have been made in Department of Plant Pathology at Taiwan Agricultural Research Institute since 1957.

In the present paper, experimental evidence confirmed the existence of physiologic races of *P. sasakii* in Taiwan.

Materials and Methods

A sclerotium was put on the center of 2 per cent agar plate. After incubation at 28°C for one day, a small piece of agar containing a single hypha was cut out and transplanted individually to potato sucrose agar plate for identifying the cultural type.

In the inoculation tests, the original isolate was transferred to a 125 cc flask

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with rice culm medium containing 2% glucose. Flask culture was incubated at 28°C for 10 days to obtain enough sclerotia for inoculation.

To determine the pathogenicity of different isolates of *P. sasakii*, inoculations were made in the green house on 16 differential varieties of rice growing separately in fungus free soil in an iron flat (30 cm×30 cm in size). Prior to the inoculation, 2% ammonium sulfate solution was top-dressed to the flats twice, at the rate of 25 cc per flat for each application. When the seedlings reach at five leaves stage, they were inoculated on the base of them with cultured cut culms containing sufficient amount of sclerotia and hyphae. After inoculation, the plants were kept for 2 days under a polythene sheet supported by a wooden frame, humidity being maintained over 90%. In the greenhouse, the present experiment was done at a temperature range from 28° to 32°C. Reading of the plant reactions was made as soon as the infected sheath could be distinguished, usually in 8 to 12 days after inoculation, depending on the environmental conditions.

Infection types shown on the 16 differential varieties were characterized as follows:

- Type 0: immune, no infection observed.
- Type 1: infection appearing only on 1st leaf-sheath.
- Type 2: infection appearing on 1st and 2nd leaf-sheaths.
- Type 3: infection appearing on 1st to 3rd leaf-sheaths.
- Type 4: infection appearing on 1st to 4th leaf-sheaths.
- Type 5: infection appearing on 1st to 5th or the youngest leaf-sheaths.

The leaves of seedling were counted from the oldest to the youngest. Types 0 to 3 were regarded as resistant type reactions, types 4 and 5 were susceptible type reactions.

The sixteen differential varieties that served to differentiate physiologic races of *Piricularia oryzae* in our Department of Plant Pathology at Taiwan Agricultural Research Institute were also used to differentiate physiologic races of *Pellicularia sasakii* in the present experiment. They were selected by the empirical method, as given in the follows:

Variety	Type	Origin
Natala	Indica, upland	Taiwan
Cutsugulcul	Indica, upland	Taiwan
Taichung-ti-chio-wu-chien	Indica, lowland	Taiwan
Kao-chio-liu-chou	Indica, lowland	Taiwan
Kaohsiung-ta-li-chen-yu	Indica, lowland	Taiwan
Kung-shan-wu-shen-ken	Japonica, lowland	Mainland China
Sencho	Japonica, lowland	Japan
Kanto 51	Japonica, lowland	Japan
Norin 21	Japonica, lowland	Japan

Chianung 230	Japonica, lowland	Taiwan
Chianung 242	Japonica, lowland	Taiwan
Kwang-fu 1	Japonica, lowland	Taiwan
Taichung 65	Japonica, lowland	Taiwan
Pai-kan-tao	Japonica, lowland	Taiwan
Taichung line 33	Japonica, lowland	Taiwan
Taichung 171	Japonica, lowland	Taiwan

Experimental Results

Cultural types — On potato sucrose medium, more than 300 isolates hitherto tested could be grouped into seven cultural types according to the rate of mycelial growth, coloration of substrate, days of sclerotial formation, number of sclerotia and other cultural characteristics of sclerotia. They are given in table 1.

Table 1. Cultural characteristics of 305 isolates on potato sucrose agar.

Cultural characteristics	Cultural type No. of isolates identified	1	2	3	4	5	6	7
		41	54	49	44	18	32	67
Length of mycelia	{ 24 hrs. 48 hrs.	1.2 4.4	1.1 4.0	1.1 4.4	1.0 3.6	1.3 4.7	0.8 3.8	1.2 5.0
Color of medium		—*	‡	+	±	+	‡	‡
Aerial mycelium		fair	good	good	fair	fair	good	good
Days of white hyphal thread formation		3	4	3	4	4	6	3
Days of scl. formation		4	5	4	5	5	7	4
No. of scl.		21.5	9	6.5	aggregated	9	4.5	14.5
Size of scl. (cm)	{ max. min.	0.16×0.06 0.03×0.02	0.17×0.09 0.06×0.03	0.16×0.03 0.06×0.04	— —	0.14×0.05 0.04×0.03	0.13×0.05 0.04×0.02	0.12×0.04 0.02×0.01
Shape of scl.		globose	irregular	irregular	—	elliptical	globose	globose
Color of scl.		sepia	cinnamon brown	dark brown	dark brown	purple brown	cinnamon brown	sepia
Places of scl. formation***	{ upper middle base	—** + +	— + +	— + +	— + +	— + +	+ + +	— + +

*_ Not blackened, ± Slightly blackened, + Blackened, ‡ Deeply blackened.

**_ No sclerotial formation, + With sclerotial formation.

*** In petri-dish.

Physiologic races — The reactions of 16 differential hosts to the seven representative isolates of *Pellicularia sasakii* (Shirai) Ito. are shown in table 2. Six physiologic races were recognized from the seven representative isolates which were grouped in accordance with their cultural characteristics. They are described as follows:

Race 1: This race brought about resistant reactions of the two upland

indica varieties and the seven locally developed *japonica* varieties except Chianung 280 and 242 varieties.

- Race 2: The five *indica* varieties except the lowland variety Kaohsiung-ta-li-chen-yu were resistant to this race.
- Race 3: This race incited resistant reactions of the three lowland *indica* varieties and susceptible reactions of the seven locally developed *japonica* varieties.
- Race 4: This race produced susceptible reactions of the 11 lowland *japonica* varieties except the variety Chianung 280.
- Race 5: The two upland *indica* varieties and the lowland *japonica* variety Kwang-fu 1 were resistant to this race, the rest gave susceptible reactions.
- Race 6: This race revealed strong virulence to cause susceptible reactions of the sixteen differentials under the experimental condition.

Table 2. Reactions of sixteen differential varieties of rice to seven representative isolates of *Pellicularia sasakii*.

Differential variety	Race	1	2	3	4	5	6
	Representative isolate	15	43	28	30	11	8 & 50
Natala		- ^a	-	+ ^b	-	-	+
Cutsugulcul		-	-	-	-	-	+
Taichung-ti-chio-wu-chien		+	-	-	-	+	+
Kao-chio-liu-chou		+	-	-	+	+	+
Kaohsiung-ta-li-chen-yu		-	+	-	+	+	+
Kung-shan-wu-shen-ken		+	+	-	+	+	+
Sencho		-	-	-	+	+	+
Kanto 51		+	+	-	+	+	+
Norin 21		+	+	+	+	+	+
Chianung 280		+	-	+	-	+	+
Chianung 242		+	-	+	+	+	+
Kwang-fu 1		-	-	+	+	-	+
Taichung 65		-	-	+	+	+	+
Pai-kan-tao		-	+	+	+	+	+
Taichung line 33		-	+	+	+	+	+
Taichung 171		-	+	+	+	+	+
Cultural type		3	6	4	5	2	1 & 7

^a=reaction types 0 to 3.

^b=reaction types 4 and 5.

Discussion and Conclusion

In the present study, more than 300 isolates of *Pellicularia sasakii* were grouped

into 7 distinct cultural types according to their cultural characteristics on potato sucrose agar. Of the seven cultural types, seven representative isolates, e.g. 8, 11, 15, 28, 30, 43, 50, were used for identifying the reaction isolates on the 16 differential varieties. Six physiologic races were differentiated. The numbers of sclerotia formed on potato sucrose agar seemed to be closely related to reactions of physiologic races on sixteen differential varieties of rice.

Matsumoto (1934) studied the physiology and parasitism of the fungus and grouped 16 strains of the fungus in Taiwan. Nakada and Kawamura (1939) identified 9 biotypes of the fungus according to the cultural characteristics on potato sucrose agar. It appeared, therefore, that the results of the present study confirmed the existence of physiologic races of *P. sasakii* in Taiwan, characterized on the bases of their ability to attack rice varieties differentially and their cultural characteristics on potato sucrose agar.

Hashioka (1951) studying on the varietal resistant to *Corticium sasakii*, reported that the variety group of the Japanese lowland type was generally more liable to infection, whereas many of the tropical varieties, especially the native Taiwan, were rather resistant. Chiu (1962) tested rice varieties and lines against sheath blight in the uniform disease nurseries which were set up at four different localities on this island in 1961. He pointed out that Chin-Gou-Tsan and Taichung native No. 1 of the native types seemed to possess a high degree of resistance, whereas *japonica* varieties were more susceptible.

So far as the 16 differential varieties of rice used for identifying the reactions of the six physiologic races were concerned, the *indica* type varieties were more resistant than the *japonica* type varieties. Among the *indica* type, the upland varieties were more distinct than the lowland varieties.

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臺灣稻紋枯病菌生理小種之研究

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摘 要

1. 自宜蘭、臺北、東勢、嘉義、屏東、臺東等地區，採集稻紋枯病青標本。經人工純系分離後，在馬鈴薯培養基上鑒別其培養型，並於溫室內舉行人工接種。所選用十六鑒別稻品種係本研究室供鑒定稻熟病菌生理小種所用者。

2. 305 個純系分離之稻紋枯病病原菌，在馬鈴薯培養基上，以其菌絲之生長，培養基之色澤，菌核之形成日期、數目、色澤、形狀及在培養皿內之位置等特性，可分為七種培養型。

3. 根據以上七種培養型中，各選出一菌號，接種於選定之鑒別稻品種上，得到六種病原性不同之生理小種，即可分類為 1, 2, 3, 4, 5 及 6 等小種。

4. 在十六鑒別稻品種上，在來稻之抗病性高於蓬萊稻。在來稻中，陸稻比水稻更顯著。