21. CAUSAL AGENTS OF CASSAVA BACTERIAL WILT IN INDONESIA

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ABSTRACT

The symptoms of so-called bacterial wilt of cassava known to occure in Indonesia were divided into three types; drooping, severe defoliation with remaining immature living leaves at the top, and die back. The former two types of symptoms were usually accompanied by affected roots, while the latter was not. Bacterial isolates from the plants showing the former two types of symptoms were identified as *Pseudomonas solanacearum*, while those from the plants showing die-back symptoms were identified as *Xanthomonas campestris* pv. *manihotis*, by their bacteriological characteristics and pathogenicity. These results indicate that two distinct diseases are included in what has been called "bacterial wilt" of cassava; bacteiral wilt in the narrow sense caused by *P. solanacearum* and bacterial die back caused by *X. campestris* pv. *manihotis*.

INTRODUCTION

Cassava (*Manihot esculenta* Crants) is one of the important crops in Indonesia being used for a secondary food as well as for producing tapioca to serve as edible starch and as material for industrial products. In resent years, bacterial wilt of cassava has become one of the important problem in cassava production, because one of the high-yielding and high-quality varieties, Kuning, is conspicuously susceptible to the disease.

In Indonesia bacterial wilt of cassava has been known as caused by *Pseudomonas solanacearum* (Smith 1896) Smith 1914, since it was first reported to occur in this country by Palm (19) in 1922 and Schwarz (21) in 1926. No other report is found on the identification of the causal bacterium. However, a doubt still remains on the identification in those early reports as mentioned below and re-examination is necessary to confirm the species of the causal bacterium.

In the reports of Palm (19) and Schwarz (21), *P. solanacearum* was inadequately described. Nevertheless, Bradbury (3) supported their identification for the reason of successful pathogenicity tests on tomatoes. Lozano (6), however, suggested that those identification might be mistaken, because another bacterium pathogenic to cassava, *Xanthomonas campestris* pv. *manihotis* (Berthet and Bondar 1915) Dye 1978, was also a white colony bacterium causing wilt syndrom as well as blight, so that it might have been confused with *P.solanacearum*.

In the present report we attempted to clarify the causal organisms of so-called cassava bacterial wilt and to discuss the difference between bacterial wilt and bacterial blight of cassava.

SYMPTOMS

So-called wilt symptoms of cassava found in the fields can be divided into three types. The first type is characterized by typical drooping (Plate I - 1,2). The affected leaves become pale green in color and droop. The vascular bundles of affected roots turn brown, and the parenchyma shows gray rot accompanied by a dark-brown boundary line in later stage (Plate I-3,4).

The second type of symptoms is characterized by severe defoliation with a few immature leaves remaining at the top (Plate II - 1-4). The affected roots show similar symptoms to the first type but in a more severe state. This type of symptoms is assumed to be the late stage of the first type, though it has not been confirmed yet.

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The third type of symptoms is characterized by die back. This type is often accompanied by drooping of lower leaves or severe defoliation. In that case this type is confusing with the other two types, though it is distinguishable by old living leaves or new sprouts at the base of dead tips (Plate III - 1,2). Roots do not show any symptoms suggesting that the disease is confined to the aerial part of the plant.

EXPERIMENTAL METHODS AND RESULTS

A. Isolation of the causal bacteria and inoculation experiments

Methods

The causal bacteria were isolated from small segments of affected tissues by dilution plate methods using nutrient agar medium. Twenty-five isolates listed in Table 1 were used for the experiment. Among them, the isolates NW03 - NW04, NW11 - NW12 and NW14 - NW16 were obtained from different parts of the same plants respectively. NW22 - NW23 and NW24 - NW25 were isolated for getting check isolates of *X. campestris pv. manihotis* and *P. solanacearum*.

These isolates were divided into two groups by their colony morphology, twenty isolates of white fluidal colonies (NW01 - NW18, NW24 - NW25) and

TABLE 1. Source of tested isolates

Isolate number	Colony type	Host plant	Cultivar	Age of plant	Symptom	Isolated from	Date of collection	Locality
NW01	WF[a)]	Cassava	Kuning	4	Severe defoliation[c)]	Upper part of stem	March 11, 1980	Tanggulangin, South Lampung
NW02	WF	Ditto	Ditto	4	Ditto	Ditto	Ditto	Ditto
NW03	WF	Ditto	Ditto	4	Drooping	Ditto	Ditto	Ditto
NW04	WF					Root		
NW05	WF	Ditto	Ditto	8	Ditto	Ditto	March 12, 1980	Banjaratu, North Lampung
NW06	WF	Ditto	Ditto	8	Ditto	Ditto	Ditto	Ditto
NW07	WF	Ditto	Ditto	8	Ditto	Upper part of stem	Ditto	Ditto
NW08	WF	Ditto	Ditto	8	Severe defoliation	Ditto	March 13, 1980	Padangratu, Central Lampung
NW09	WF	Ditto	Ditto	8	Ditto	Ditto	Ditto	Ditto
NW10	WF	Ditto	Ditto	8	Ditto	Ditto	Ditto	Ditto
NW11	WF	*Ditto*	*Ditto*	8	*Ditto*	Ditto	*Ditto*	*Ditto*
NW12	WF					Root		
NW13	WF	Ditto	Ditto	8	Ditto	Ditto	Ditto	Ditto
NW14	WF	Ditto	Unknown	6	Severe defoliation	Upper part of stem	March 27, 1980	Borobudur, Central Java
NW15	WF					Lower part of stem		
NW16	WF					Root		
NW17	WF	Ditto	Ditto	6	Ditto	Ditto	Ditto	Ditto
NW18	WF	Ditto	Ditto	6	Ditto	Ditto	Ditto	Ditto
NW19	WM[b)]	Ditto	GL–17	0.5	Dead plant	Stem	March 12, 1980	Tamanbogo, Central Lampung
NW20	WM	Ditto	Kuning	3	Die back[d)]	Upper part of stem	March 13, 1980	Blambanganpagar, North Lampung
NW21	WM	Ditto	Gading	6	Die back[e)]	Ditto	April 7, 1980	Muara, West Java
NW22	WM	Ditto	Unknown	7	Angular leaf spot	Leaf	March 6, 1980	Cikeumeuh, West Java
NW23	WM	Ditto	Ditto	7	Leaf blight	Ditto	Ditto	Ditto
NW24	WF	Tomato	Unknown	2	Drooping	Stem	March 5, 1980	Sukabumi, West Java
NW25	WF	Ditto	Ditto	2	Ditto	Ditto	Ditto	Ditto

a) WF: white fluidal colony. b) WM: white mucoid colony. c) Severe defoliation with living immature leaves remained at the top. d) Die back accompanied by drooping of leaves. e) Die back accompanied by severe defoliation.

five isolates of white mucoid colonies (NW19 - NW23). The former isolates were obtained from the diseased plants showing the first and second types of symptoms while the latter were obtained from those showing the third type of symptoms.

The isolates were tested for their pathogenicity to cassava var. Kuning (No. 554) and var. No. W1705, tomato var. Gondol, and tobacco var. Blight Yellow. Each one to two month-old plant was stab-inoculated at two positions on the stem 2 to 5 cm lower from the tip, by a tooth stick smeared with bacteria grown on PPGA (18) for two days.

Results

Twenty isolates of white fluidal colonies showed pathogenicity on cassava var. Kuning, tomato and tobacoo. Symptoms on cassava appeared one week after inoculation showing a few drooping leaves and bronwish-colored longitudinal streaks on the stem near the inoculation points. Later on, some plants showed drooping of whole leaves followed by severe defoliation except a few immature leaves at the top (Plate IV -1,2), while others restored their growth without showing any advanced symptoms.

Tomato and tobacco plants wilted about four days after inoculation showing brownish-colored longitudinal streaks on their stems, and then their growing tips were killed (Plate IV - 3).

Five isolates of white mucoid colonies were pathogenic to cassava var. Kuning and No. W1705, but they did not attack tomato and tobacco plants. The affected plants of var. Kuning showed drooping of the leaves near the infection sites about one week after inoculation, then their growing tips were killed though their lower leaves did not show any symptoms at all (Plate IV - 4). Such typical die-back symptoms appeared two weeks after inoculation. Gum exudation was observed at the points of inoculation.

The appearance of disease symptoms on var. No. W1705 usually delayed for a few days as compared with var. Kuning, though there was no difference between them in the late stage of the disease.

B. Characteristics of the test isolates

Methods

Morphological properties were observed by the use of electron microscope. For the investigation of bacteriological characteristics each isolate grown on PPGA slant for one to two days was suspended in sterile water at a concentration of about 10^{10} cells/ml to serve as the source of inoculum. Each test medium was inoculated with one loopful or one-needle amount of the source suspension. All tests except growth temperature were conducted at 25°C.

Gram discrimination was done by Ryu's method (20). Oxidation-fermentation (O-F) test was done by Hugh and Leifson's method (8). Activities of oxidase, arginine dihydrolase, urease, tyrosinase and β-glucosidase (hydrolysis of esculin) were detected by the methods of Kovacs (14), Thornley (24), Christensen (4), Lelliott *et al.* (15) and Sneath (22), respectively. Hypersensitivity reaction on tobacco leaves was tested on the leaves of var. Bright Yellow by Klement's method (12) using bacterial suspension at a concentration of 10^8 cells/ml.

Reduction of nitrate and gas formation from nitrate were determined in the nutrient agar slant added with 0.1 % nitrate after two and three day's incubation. Anaerobic growth in the nutrient broth containing nitrate (nitrate respiration) was observed by the method of Komagata *et al.* (13), except that the concentration of nitrate was reduced to 0.1 %. Motility was observed in the semi-solid media of O-F test and arginine dihydrolase activity test. Production of hydrogen sulfide was detected by lead acetate paper. Growth in nutrient broth at high temperatures was tested in water bath at 35, 37 and 39°C, and bacterial growth was observed daily for four days. Tolerance of salt was tested at concentrations of 1 and 2 % in peptone water. Tolerance of triphenyltetrazolium chloride (TTC) was tested by Kelman's method (9) at concentrations of 0.02, 0.1 and 0.2%. Utilization of L-asparagine as a sole source of carbon and nitrogen was tested by Starrr and Weiss' method (23), except that the bacteria grown in the medium were transferred at four-day intervals and that non-growth isolates were transferred at eight-day intervals before checking their growth on the PPGA slants.

Egg-yolk reaction (lecithinase activity) and production of fluorescent pigment on King's B medium (11) were observed two and five days after inoculation. Acid production from glucose, sucrose, mannitol, sorbitol and galactitol was detected in the basal medium of Ayers *et al.* (1) added with 1 % of each carbohydrate. Acid production from lactose, maltose, mannitol and sorbitol was detected by the same method as above with addition of 0.1 % peptone. The observation was made for 14 days. The sudanophilic character of cells was determined by Hayward's method (6).

Results

a) White fluidal colony isolates

The bacteria were short-rod-shaped, with round ends, 0.62 x 1.34 μm, in mean size (isolate NW06; 0.56 x 1.14 μm, NW11; 0.70 x 1.42 μm, NW17; 0.60 x 1.46 μm). One to two flagella were attached to an end. They grew rapidly on nutrient agar plates to form colonies which were dirty white and fluidal. Fluidal colonies were observed on PSA (26) and PPGA media in more typical form than on the nutrient agar medium.

The isolates were aerobic and Gram-negative. They decomposed glucose oxidatively, but did not produce yellowish green fluorescent pigment and hydrogen sulfide. They showed positive reactions of oxidase, catalase and tyrosinase activity. They reduced nitrate to nitrite, and gas formation was observed in the nitrate medium after three days incubation. They grew anaerobically in the nutrient broth containing nitrate. They accumulated poly-β-hydroxybutyrate in their bodies and utilized asparagine as a sole source of carbon and nitrogen. Tests of arginine dihydrolase, β-glucosidase, urease and lecithinase activity showed negative results.

The isolates grew well on nutrient agar slants containing 0.02 % TTC and grew weakly at 0.1 % TTC (except NW13, NW17), but no growth was observed at 0.2 % TTC. They did not grow in the peptone water containing 1 % NaCl. They grew at 37°C but did not at 39°C. Motility was observed in the semi-solid media. Test for hypersensitivity reaction on tobacco leaves was positive. They produced acid from glucose, sucrose, mannitol, sorbitol and galactitol within seven days incubation. Acid production from lactose and maltose was variable with the isolates. Seven isolates, NW14 - NW18 and NW24 - NW25, were positive, but others showed negative reaction.

b) White mucoid colony isolates

The bacteria were short-rod-shaped, with round ends, 0.66 x 1.87 μm in mean size (isolate NW19), having a single polar flagellum. They grew rapidly on a nutrient agar medium to form colonies which were milky white and mucoid. The mucoid colonies were more typically observed on PSA and PPGA media.

The isolates were strictly aerobic and Gram-negative. They decomposed glucose oxidatively and produced hydrogen sulfide, but did not produce any pigments. They showed positive reaction for catalase, β-glucosidase and lecithinase activity and delayed positive reaction for oxidase activity, but negative reaction for tyrosinase, urease and arginie dihydrolase activity. They did not reduce nitrate to nitrite and did not grow anaerobically in the nutrient broth containing nitrate. They did not grow in asparagine medium in which asparagine was a sole source of carbon and nitrogen. They accumulated poly-β-hydroxybutyrate in their bodies. Their growth was inhibited by 0.02 % TTC, but not by 2 % NaCl. They did not grow at 35°C. Motility was observed in the semi-solid media. Test for hypersensitivity reaction on tobacco leaves was negative. They produced acid from glucose and sucrose in delayed reaction, but did not from the other tested carbohydrates, except that one isolate (NW20) produced acid from lactose in delayed reaction.

DISCUSSION

Twenty-five isolates tested here were divided into two groups by their colony morphology, twenty isolates of fluidal colonies and five isolates of mucoid colonies. The difference in colony morphology was related closely to the difference in their biochemical characteristics and pathogenicity. Isolates belong to the same group showed quite uniform characters. These results suggest that the tested isolates belong to two different species of bacteria.

The twenty isolates of white fluidal colonies, NW01 - NW18 and NW24 - NW25, were short-rod-shaped, with polar flagella, aerobic, catalase-positive, Gram-negative, and plant pathogenic. They showed oxidative-type reaction in O-F test, grew anaerobically in the nutrient broth containing nitrate, and grew in asparagine medium in which asparagine was a sole source of carbon and nitrogen. These results indicate that the isolates belong to the genus *Pseudomonas*.

These isolates accumulated poly-β-hydroxybutyrate intracellularly and did not require growth factors. They did not grow at 39°C, did not show arginine dihydrolase activity, and did not produce green fluorescent pigment. They utilized sucrose as a sole carbon source and produced acid from it. According to the key to the genus *Pseudomonas* in Bergey's Manual (5), these results suggest that the isolates belong to one of the strains of *P. solanacearum*. The same conclusion was also led by the key of Bradbury (2) and Nishiyama (17). Characteristics of these isolates were therefore compared with those of *P. solanacearum* (Table 2 and 3).

The isolates showed different reaction from the Hayward's description (6) of the neotype strain in tolerance of 1 % NaCl, acid production from some carbohydrates, and gas formation from nitrate. However, less tolerance of NaCl is one of the typical characters of *P. solanacearum* (7) and acid production from carbohydrates and gas formation from nitrate are known to be variable with its biovars (6). As seen in Table 3, thirteen isolates examined here showed the same reactions as those of biovar IV of *P. solanacearum* and seven others showed those of biovar III.

In the pathogenicity test, all the tested isolates, of which eighteen were from cassava and two from tomato, attacked cassava, tomato and tobacco in the same manner and produced similar symptoms to each other.

From the above-mentioned bacteriological characteristics and pathogenicity, it is clear that the thirteen isolates of white fluidal colonies belong to biovar IV of *Pseudomonas solanacearum* (Smith 1896) Smith 1914 and seven other isolates belong to biovar III of the species.

The five isolates of white mucoid colony, NW19 - NW23, were short-rod-shaped, with a single polar flagellum, aerobic, catalase-positive, Gram-negative, less tolerant of TTC, and plant-pathogenic. They did not grow in asparagine medium in which asparagine was a sole source of carbon and nitrogen, and did not produce nitrite. These results indicate that the isolates belong to the genus *Xanthomonas*.

Non-pigmented xanthomonads are known to be very few. The present isolates are quite similar in their characteristics to the Indonesian isolates from cassava bacterial blight investigated previously (25), except the growth at 35°C. They were therefore identified as *Xanthomonas campestris* pv. *manihotis* (Berthet and Bonder 1915) Dye 1978.

Through this study it is quite apparent that the so-called bacterial wilt of cassava is caused by two kinds of bacteria, *P. solanacearum* and *X. campestris* pv. *manihotis*. There were close relationships between symptoms and the species of bacteria isolated. *P. solanacearum* was isolated from the plants showing drooping or severe defoliation, while *X. campestris* pv. *manihotis* was isolated from the plants showing die-back symptoms. *P. solanacearum* was isolated also from the roots, while *X. campestris* pv. *manihotis* was not isolated from the roots. As seen in Table 4, the two kinds of bacteria are widely different in their characteristics from each other. In recent reports

TABLE 2. Characteristics of white fluidal colony isolates as compared with *Pseudomonas solanacearum*

Property	Present 20 isolates	*P. solanacearum*	
		Neotype strain[a]	Other strains
Gram	–	–	
Oxidase	+	+	
Catalase	+	+	
Fluorescent pigment	–	–	
Growth factor requirement	–		– (5, 6)
Motility	+	+	+/– (10)
Nitrate reduction	+	+	
Gas from nitrate	+	–	+/– (6)
Nitrate respiration	+		+ (5)
Arginine dihydrolase	–		– (5, 7)
Hydrolysis of esculin	–	–	
Tyrosinase	+	+	
Urease	–		+ (7)
Poly-β-hydroxybutyrate accumulation	+	+	
Tolerance of 1 % NaCl	–	+	
2 % NaCl	–	–	
Growth at 37°C	+	+	
40°C	–	–	
Acid production from			
Glucose	+	+	
Sucrose	+	+	
Lactose	+7/–13	–	+/– (6)
Maltose	+7/–13	–	+/– (6)
Mannitol	+	–	+/– (6)
Sorbitol	+	–	+/– (6)
Galactitol	+	–	+/– (6)

+ : positive, – : negative. a) Description by Hayward (6).

TABLE 3. Characteristics of *Pseudomonas solanacearum* variable with its biovars and those of present isolates

Property	Biovar of *P. solanacearum*[a]				Present isolates		
	I	II	III	IV	NW01-NW13	NW14-NW18	NW24 & NW25
Acid production from							
Lactose[b]	–	+	+	–	–	+	+
Maltose[b]	–	+	+	–	–	+	+
Mannitol	–	–	+	+	+	+	+
Sorbitol	–	–	+	+	+	+	+
Galactitol	–	–	+	+	+	+	+

+ : positive, – : negative. a) Description by Hayward (6).
b) Basal medium contains 0.1 % peptone.

on cassava bacterial diseases, the term "bacterial wilt" tends to be used in a broader sense than in the case of other crops. In order to avoid the possible confusion, these two diseases should be distinguished more strictly.

TABLE 4. Differential characteristics between *Pseudomons solanacearum* and *Xanthomonas campestris* pv. *manihotis*

Property	*P. solanacearum*	*X. campestris* pv. *manihotis*
Colony on sugar-containing medium	White fluidal	White mucoid
H_2S production	–	+
Hydrolysis of esculin	–	+
Egg–yolk reaction	–	+
Tolerance of 2 % NaCl	–	+
Nitrate respiration	+	–
Nitrate reduction	+	–
Gas from nitrate	+	–
Utilization of asparagine as a sole source of C & N	+	–
Tyrosinase	+	–
Acid production from		
Mannitol	+	–
Sorbitol	+	–
Galactitol	+	–
Tolerance of 0.02 % TTC	+	–
Growth at 37°C	+	–
Tobacco hypersensitivity	+	–
Pathogenicity to tomato	+	–
tobacco	+	–
Typical symptoms on cassave	Drooping, defoliation & browning of root	Die back, leaf blight & leaf spot

+ : positive, – : negative.

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摘　　要

インドネシアにおけるキャッサバ bacterial wiltの病原について

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インドネシアにおけるキャッサバ生産の主な阻害要因の1つに，bacterial wiltと称される病気がある。本病の病原は1920年代に*Pseudomonas solanacearum*と同定されたが，異論もあり，他国では*Xanthomonas campestris* pv. *manihotis* によるとされているため，再検討を行った。罹病植物はしおれ，落葉，die-backの3症状に大別された。前2者では茎と塊根から汚白色で流動性に富む細菌が分離され，キャッサバ，トマト，タバコに病原性を示したが，die-back症からの分離細菌は乳白色で粘性に富み，キャッサバに病原性を示し，トマト，タバコには病原性がなかった。流動性に富む18菌株と粘性に富む3菌株に，対照として青枯病罹病トマト茎とbacterial blight罹病キャッサバ葉からの分離細菌を各2菌株加え，細菌学的性質を調べた。その結果，流動性に富む細菌は*P. solanacearum* のbiovar III（5菌株）とIV（13菌株），粘性に富む細菌は*X. campestris* pv. *manihotis* と同定された。よって，いわゆるbacterial wiltは2種の細菌による病気の総称であると結論した。なお，茎の先端の生死と塊根の罹病の有無に注目すれば原因菌の推定が可能である。すなわち，塊根が侵され茎の先端が生き残っている場合は*P. solanacearum*，茎の先端が枯れ塊根が健全な場合は*X. campestris* pv. *manihotis* である。

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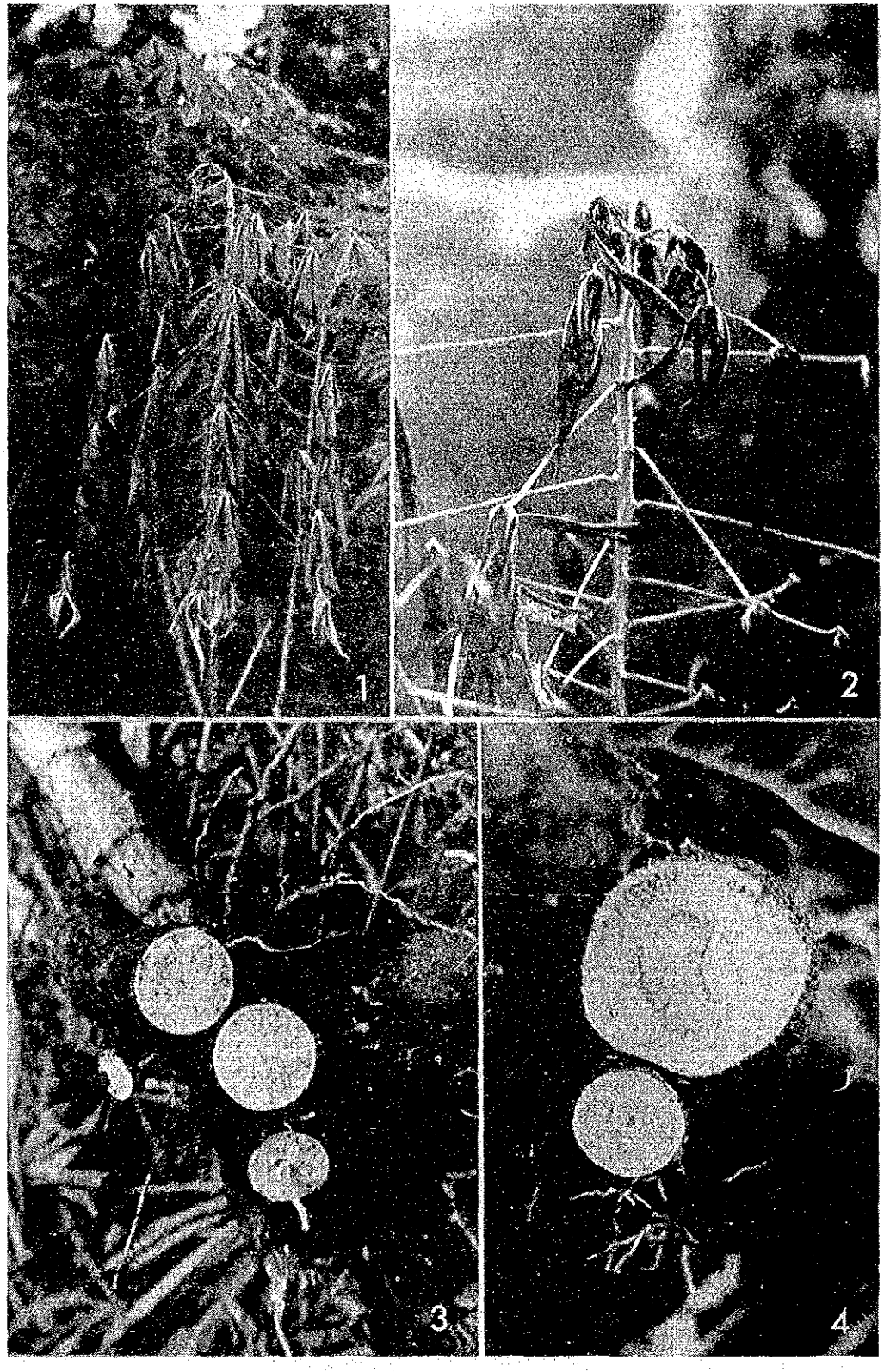


Plate I.

1 and 2. A drooping cassava plant.

3 and 4. Affected cassava roots.

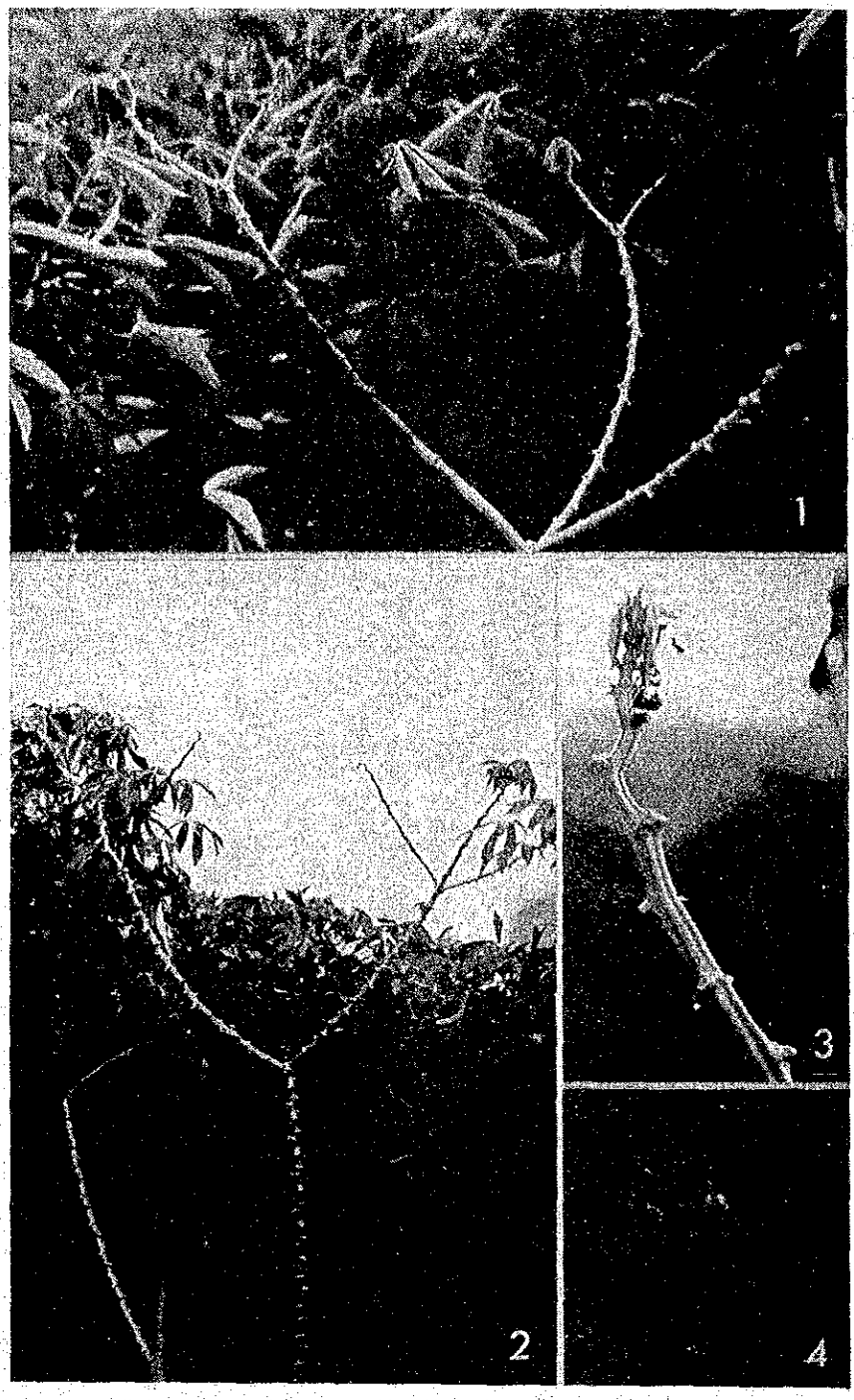
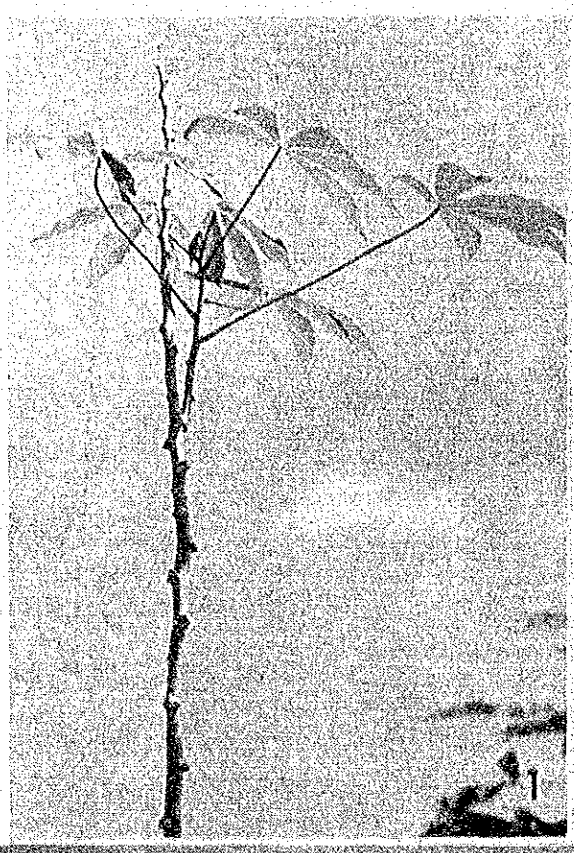


Plate II.

1 to 4. Cassava plants showing severe defoliation.
A few immature leaves are still living.



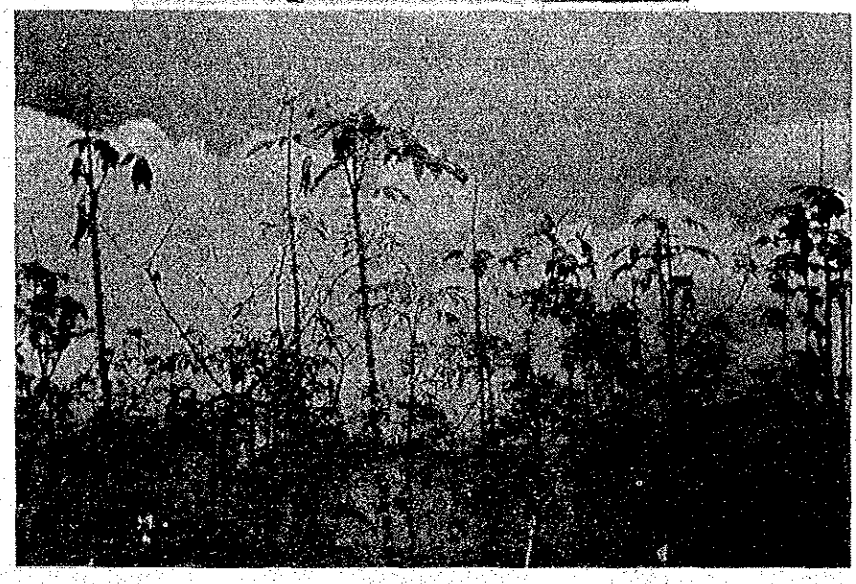


Plate III.

1 and 2. Cassava plants showing die-back symptom. New sprouts are growing to replace the dead tips.

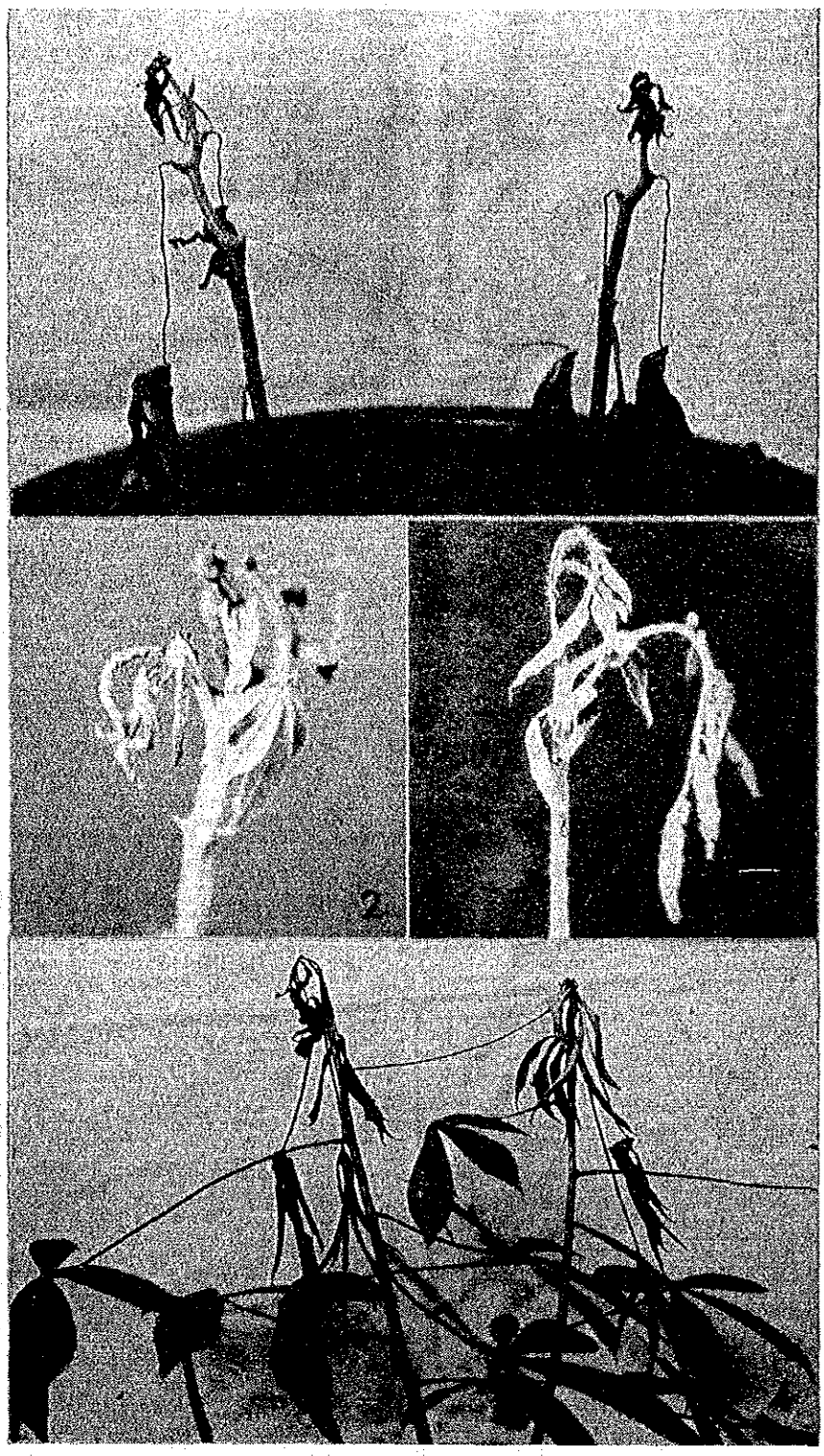


Plate IV.

1 and 2. Cassava plants inoculated with a white fluidal colony isolate.

3. A tomato plant inoculated with a white fluidal colony isolate.

4. A cassava plant inoculated with a white mucoid colony isolate.

22. INTERIM REPORT OF THE RESEARCH ON RACES OF *PYRICULARIA ORYZAE* AND THE VARIETAL RESISTANCE OF RICE IN INDONESIA

Reiichi YOSHINO,*

Rice blast had been thought as a disease of upland rice and rather mild disease in Indonesia for a long time. I heard and read that the incidence of blast disease in uplant fields has been increased year by year with the increase of nitrogen fertilizer application and introducing newly high yield varieties such as IR-30, IR-42 etc. and severe occurrence of this disease has been often reported even in lowland fields.

I have fortunately had chances to visit many places such as Sukamandi, Lembang, Pacet, Muara, Tanjungdarang, Tamanbogo, Palembang and Sukabumi and observed disease occurrences in upland and lowland fields. Throughout limited observations, bacterial leaf blight, sheath blight and sheath rot seemed to be important diseases in lowland fields. Among these diseases, bacterial leaf blight was most severe and sheath blight was the second. For sheath rot, there seemed to be some differences with varieties cultivated, that is, sheath rot occurred more severely in fields where varieties released from IRRI were cultivated. As you know, IRRI varieties have a character that heading of panicles is slower or incomplete. This character may combine with severe occurrence of sheath rot.

In uplant fields, *Cercospora* leaf spot and *Helminthosporium* leaf spot were predominant and severe throughout my observations. These fungus also caused severe occurrence of discolouration of panicles in many upland fields. *Fusarium* leaf spot and sheath blight also occurred severely in some places.

Concerning blast disease, unfortunately I could observe any severe occurrence neither in upland nor lowland fields of farmer's, though I could observe severe outbreak of leaf and panicle blast in upland fields in Tamanbog and Pacet where Mr. Otjim Sumantri is carrying out some experiments on varietal resistance and affecting factors for blast occurrence such as nitrogen fertilizer application and spraying fungicides.

"Why does blast disease not break out so severely even under upland conditions in farmer's fields" is my frank question about blast occurrence in this country and I think that blast disease has not yet reached to an important problem for actual rice production. But, at the same time, I would like to say that blast disease will become one of important disease with the increase of nitrogen fertilizer application and introducing newly high yield varieties in future, because I have had the chance to see severely infected seedling of IR-42 by leaf blast from Kendari in South East Sulawesi where leaf blast has occurred in more than 300 ha of upland fields. Only by this fact, I also think that it seems very important to establish an Indonesian set of differential varieties for identifying races of rice blast fungus as to know predominant races in this country.

The present researches on rice and weeds blast were carried out at the Bogor Research Institute for Food Crops, during the period from March to May in 1981, according to the following lines.

1. Study on the distribution of physiological races of *Pyricularia oryzae* and varietal resistance in Indonesia from reports and literatures previously published.

2. Identification of physiological races of *P. oryzae* and selection of some temporary standard isolates of races
   1). Identification of Physiological races
   2). Reaction of isolate on Japanese differential varieties
   3). Selection of some temporary standard isolates

3. Grouping of Indonesia rice varieties based on the reaction to the temporary standard isolates

4. Observation, isolation and inoculation test of *Pyricularia* sp. on weeds

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I wish to express my cordial thanks to Dr. Rusli Hakim, the Director of Central Research and Development Institute for Foods Crops; Dr. Dewa Made Tantera, the Chief of Pest and Disease Division and Ir. Mukelar Amir, the Chief of Plant Pathology Section for their continuous encouragement and proper advice.

I also wish to express my cordial thanks to all staff members of Plant Pathology Section for their friendly advice and giving benefits for my work.

I am heatily pleased to acknowledge the earnest and eager assistance of Mr. Otjim Sumantri, my counter part, and other members of Plant Pathology Section in carrying out of researches.

I am deeply indebted to Dr. Setsuro Toda, the team leader of the Project "Strengthening of Legumes in relation to Cropping Systems", Dr. Takeo Yamaguchi, a staff members of this Project and plant pathologist and other staff members for their critical advice and guidance.

(1) STUDY ON THE DISTRIBUTION OF PHYSIOLOGICAL RACES OF *PYRICULARIA ORYZAE* AND VARIETAL RESISTANCE IN INDONESIA FROM REPORTS AND LITERATURES PREVIOUSLY PUBLISHED

Reiichi YOSHINO*

Some informations about the distribution of physiological races and varietal resistance in Indonesia were got from seven reports and literatures previously published. The contents of these are briefly described as follows.

B.H. Siwi and I.N. Oka (1967) reported that varieties Bengawan, Sigadis, Remaja, Djelita, Dara, Syntha and Dewitara were highly susceptible in the 1964 test, although some upland varieties Subudjang, Malio and Leter were comparatively resistant, on "the Symposium on rice diseases and their control by growing resistant varieties and other measures". They also reported that there were at least three physiological races of blast in West Java and South Sumatra. We can know from their table that three isolates belonged to ID group and another isolate to IE group, though we can not know their correct numbers in groups because of lacking of reaction results on Sha-tiao-tsao (S).

Matsumoto S., T. Kozaka and M. Yamada (1969) tested pathogenic reactions of more than 300 isolates collected from 10 countries in Asia. They reported that 74 isolates collected from West Java and South Sumatra in 1964 were classified in 12 pathogenic patterns and these isolates were divided in two widely different groups. The first group could not infect generally called Chinese type varieties, namely, Chokoto, Yakeiko, Kanto 51, CI. 5309 and Dular, and this group of isolates was popular in the South East Asia such as Philippines and Vietnam.

The second group of isolates could infect these varieties and was widely found around India. We can pull out many informations about races in Indonesia from their data. I converted international race numbers, which they had named, to new international race numbers which K. C. Ling and S. H. Ou had proposed in 1969, because their experiments had been conducted before Ling's proposal. Converted results are shown in Table 1.

TABLE 1 Pathogenic reactions of international differentials to isolates from Indonesia in 1964 (Converted from TABLE 16 in the report of Matsumoto et al.)

Differentials / Race type	Raminard str. 3	Zenith	NP. 125	Usen	Dular	Kanto 51	Sha-tiaotsao (S)	Caloro	Number of isolates
IA – 33	S	S	R	S	S	S	S	S	3
IA – 109	S	R	R	S	R	R	S	S	1
IC – 1	R	R	S	S	S	S	S	S	7
IC – 17	R	R	S	R	S	S	S	S	2
IC – 25	R	R	S	R	R	S	S	S	7
ID – 1	R	R	R	S	S	S	S	S	12
ID – 9	R	R	R	S	R	S	S	S	3
ID – 10	R	R	R	S	R	S	S	R	7
ID – 13	R	R	R	S	R	R	S	S	29
IE – 1	R	R	R	R	S	S	S	S	2
Number of isolates Which can invade each differential	4	3	16	62	26	43	73	66	Total 73
% invasion	5.5	4.1	21.9	84.9	35.6	58.9	100	90.4	–

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Among 73 isolates, 4, 10, 51 and 2 isolates belonged to IA, IC, ID and IE group respectively. So we can suppose that races of ID group were predominant and especially ID-13 was predominant in 1964. We can also know number of isolates which had pathogenicity to each international differentials. All of isolates could invade Sha-tiao-tsao (S) and 90.4 and 84.9 % of isolates had pathogenicity to Caloro and Usen respectively. To Kanto 51, 58.9 % of isolates had pathogenicity. On the other hand, numbers of pathogenic isolates to NP. 125 and Dular were rather fewer and only four and three isolates could invade Raminard Str. 3 and Zenith respectively.

Table 2, which was also made up from the data of Matsumoto et al., shows distribution of races in West Java and Lampung. When we devided races into two groups based on the reaction of Kanto 51, as Matsumoto et al. had pointed out, very interesting facts were found out in Table 2. There were only 6 race types and 25 % among 24 isolates could invade Kanto 51 in West Java, while the constitution of races was more complicated in Lampung. There were 12 types of race in Lampung and 75.5 % among 49 isolates could invade Kanto 51 in 1964. This result shows that the distribution of races would differ with island or location in Indonesia.

Kozaka, T., S. Matsumot and M. Yamada (1970) examined reactions of 691 varieties from 19 countries in the world to 21 isolates of *Pyricularia oryzae* representing majer races in Asia. In their results, Rantai Emas 2 was resistant to all isolates tested. Bengawan, Peta, Remadja, Sigadis and Tjina were included in Peta group which was resistant to all Japanese isolates, but susceptible to Is-30 (IC-17) among foreign isolates. Oerang-oerangan was in Norin 20 group which was susceptible to all Japanese isolates, but resistant to all foreign isolates tested. Sidny and Djitjih Tjampaka belonged to Kameji group which was susceptible to all Japanese and foreign isolates except OR-10 (IA-97) and Deras (ID-6).

Sigehisa Kiyosawa (1974) reported that the gene Pi-b was found out in lines developed by crossing Tjina, Tjahaya or Bengawan with Japanese varieties, and Pi-t in lines developed from a hybrid Tjahaya X Norin 25.

Table 2 **Relation between race type and location in Indonesia in 1964 (made up from the result of Matsumoto et al.)**

Reaction of Kanto 51										
Race type	IA	ID	IA	IC	IC	IC	ID	ID	ID	IE
Samples / location	109	13	33	1	17	25	1	9	10	1
West Java										
Citayam		12		1	1	1	2			
Bogor		6				1				
Sub-total		18		1	1	2	2			
% isolates		75.0					25.0			
Lampung*										
Tamanbogo	1	10				1			7	
Kota Gajah				4		3	2	1		
Seputih Raman		1	3	1	1	1	3	2		2
Pekalongan				1			4			
Djodjog							1			
Sub-total	1	11	3	6	1	5	10	3	7	2
% isolates		24.5					75.5			
Total	1	29	3	7	2	7	12	3	7	2
% isolates		41.1					58.9			

* South Sumatra in the original Table

Mukelar Amir and T. Yamaguchi (1975) tested pathogenicity of 11 single conidial isolates collected from West Java, West Sumatra and Lampung from 1973 to 1974 for international differentials. IF-1 was the most predominant race in their test and numbers of isolates which could invade Caloro, Sha-tiao-tsao (S), Kanto 51 and Usen were 8, 9, 6 and 4 respectively, though only one isolate had pathogenicity to NP-125 and no isolate to Raminard Str 3, Zenith and Dular. The most predominant race was different from the result of previous Matsumoto's research, that had been ID-13, but the general tendency of dominant distribution of isolates pathogenic to Usen, Kanto 51, Sha-tiao-tsao (S) and Caloro did not differ. They also showed clear differences in the distribution of race with location. All of 6 isolates sample from West Java had pathogenicity to Kanto 51, though isolates from West Sumatra and Lampung had not. 2 isolates from West Sumatra had pathogenicity to Caloro and had not to Sha-tiao-tsao (S). On the contrary, 3 isolates from Lampung had pathogenicity to Sha-tiao-tsao (S) and had not to Caloro.

Takashi Kobayashi (1978), who carried out some researches on blast disease in Indonesia, wrote that IR-24, C4-63gb, Pelita I/1 and Pelita I/2 showed different reactions from PB-5, PB-8 and Syntha, although these all varieties were derived from Peta. He also clarified that the reaction of PB-30 were almost same as those Toride 1 which is one of Japanese differentials, and Kencana was susceptible to all isolates tested. So he recommended to use Kencana as a variety for the check of pathogenicity or virulence of isolates. He pointed out the difficulty of selection of pathogenic differentials from Indonesian varieties because of their complicated reactions to isolates tested.

In another report, he wrote that races from IB to IH group seemed to exsist in Indonesia and ID group seemed to be predominant at least in Java island.

Masaharu Noda (1980), who stayed as an expert of cultivation in Lampung Tani Makmur Project for two years from 1978 to 1980, reported that Sirendah, which is one of upland local varieties, and Klemas were comparatively resistant to leaf and panicle blast in his field tests.

I summarized results of these reports as follows.

1). Variety : Although there may exsist various varieties which have different resistant genes in Indonesia, there are apparently resistant varieties such as Rantai Emas 2, Sirendah, Klemas etc.
These varieties shall be tested on their resistance with other leading varieties in Indonesia by some standard isolates of *Pyricularia oryzae*. And very susceptible variety "Kencana" is a candidate of Differential varieties.

2). Race : There exsist many race groups belonged to from IA to II in Indonesia and the distribution of races may differ with location or island. The most prevarent race group in them may be ID group and many isolates in this country have ability to invade Usen, Kanto 51, Sha-tiao-tsao (S) and Caloro. So, at least some isolate which have pathogenicity to these four varieties shall be prefered as standard isolates.

(2) IDENTIFICATION OF PHYSIOLOGICAL RACES OF *P. ORYZAE* AND SELECTION OF SOME TEMPORARY STANDARD ISOLATES OF RACES

Reiichi YOSHINO* and Otjim SUMANTRI**

1) IDENTIFICATION OF PHYSIOLOGICAL RACES

(1) Materials and methods

For the identification of physiological races of *P. oryzae*, 72 isolates obtained from diseased leaves and panicles by monoconidial isolation method from 1973 to 1981 were tested. The source of the isolates tested are shown in Table 3. Monoconidial isolation was conducted with the same method that Dr. Takashi Kobayashi reported in his interim report and all isolations were carried out by Mr. Otjim Sumantri. Some of the isolates had lost their viability and some had lost their sporulation ability when I dealt with the isolates. These isolates were excluded from the identification.

Seeds of the International Differentials were sent from International Rice Research Institute. Prior to sowing, seeds were soaked in 0.05 % of seed disinfectant for 24 hours and in tap water for more 24 hours. Germinating seeds were sown in 5 cm x 15 cm x 10 cm plastic seedling case. Four varieties were sown in one case and eight seeds for each variety. N. P_2O_5 and K_2O were applied by 1g for each case respectively. 0.1 % solution of Tachigaren (3-hydroxy-5-methyl isoxazol) was pored on each case immediately after sowing to prevent the occurrence of take all disease of seedlings. The seedlings were inoculated at about fouth leaf stage by the spraying method.

To obtain sufficient number of spores for inoculation test, each isolates was plate-cultured on oat-meal agar at 28°C for 10 days and then aerial mycelia was washed off with the sterilized water containing or not containing 0.03 g of Streptmycin in 1 ℓ by brushing the surface of the culture using painting brush. Washed cultures were exposed to the fluorescent light in an incubation box for two days. Spores formed on the surface of the culture were suspended in 0.02 % of Tween 20 solution and the spore concentration was adjusted to be about 20×10^4 per 1 ml using heamacytometer. About 20 ml of spore suspension was sprayed for one seedling case by glass nozzle sprayer. Inoculated seedlings were kept in a moist chamber at 27°C for 24 hours and then transferred to a net house. Seven days after inoculation, lesions appeared on leaves were observed. These procedures for culturing isolates, raising seedlings and inoculation were carried out throughout all studies in this report.

(2) Result and Discussion

Ir. Mukelar Amir and Mr. Otjim Sumantri had conducted identification of physiological races for more than half of the isolates collected before this experiment. Including their results, obtained results are shown in Table 4 and 5. 50 isolates out of 72 collected isolates were identified and classified into 16 races as shown in Table 5, i.e. IB-63, IC-1, IC-15, IC-17, ID-5, ID-9, ID-11, ID-13, ID-14, ID-15, ID-16, IF-1, IG-1, IG-2, IH-1, II. In these races, IG-1, IG-2, ID-15 and ID-13 were predominant.

Among 50 isolates, only one isolate had the pathogenicity to Zenith and no isolate to Raminad Str. 3. On the other hand, 76.0, 70.0 and 42.0 % of isolates identified had the pathogenicity to Caloro, Sha-tiao-tsao (S) and Usen respectively. To Kanto 51, 16.0 % of isolates had the affinity. These results seemed not to differ so widely from results of the previous studies discribed in the section one of this report except low percentage of isolates infective to Kanto 51. For the distribution of races, any distinct differences were not found out with locations in Indonesia in this experiment.

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TABLE 3. List of *Pyticularia oryzae* cav. isolates

No.	No code	Date of isolation	Varieties	Location	Part of samples	
1.	P02-7301	7 – 12 – 73	Gropak Gede 106	Lampegan/Sukabumi	Leaf	Upland
2.	P02-7302	14 – 12 – 73	Padi Salam	"	"	"
3.	P02-7303	15 – 12 – 73	Jambe	"	"	"
4.	P02-7304	17 – 12 – 73	Kantong	"	"	"
5.	P02-7305	17 – 12 – 73	Gropak Gede 106	"	"	"
6.	P02-7306	17 – 12 – 73	Genjah Lampung	"	"	"
7.	P02-7307	22 – 12 – 73	PB 5	"	"	"
8.	P05-7301	27 – 12 – 73	Cempo Ondel	Wates, Wonosari, Yogya	"	Lowland
9.	P012-7301	27 – 12 – 73	Genjah Lampung	Tamanbogo, Lampung	"	Upland
10.	P012-7302	27 – 12 – 73	PB 5	"	"	"
11.	P02-7401	11 – 1 – 74	Dara	Lampegan/Sukabumi	"	"
12.	P02-7402	11 – 1 – 74	Sogleng	Gunung Geulis/Sukabumi	"	"
13.	P02-7403	11 – 1 – 74	Tadukan	Lampegan/Sukabumi	"	"
14.	P012-7401	8 – 2 – 74	Bicol	Tamanbogo, Lampung	"	"
15.	P012-7402	12 – 3 – 74	Roma	"	"	"
16.	P08-7401	12 – 7 – 74	Pelita I/1	Rambatan/Wst. Sumatra	Seed	Lowland
17.	P08-7402	14 – 7 – 74	PB 5	"	Leaf	"
18.	P02-7501	24 – 1 – 75	Gama 61	Selawu, Tasik Malaya	"	Upland
19.	P04-7501	20 – 5 – 75	C4-63	Tulungagung, East java	Neck	"
20.	P012-7501	20 – 5 – 75	Bicol	Tamanbogo, Lampung	Neck	"
21.	P012-7502	20 – 5 – 75	B2385 c	Tamanbogo, Lampung	Leaf	"
22.	P012-7503	2 – 12 – 75	B 9 c	"	Neck	"
23.	P012-7601	21 – 1 – 76	Lokal	Kotabumi/North Lampung	Leaf	"
24.	P02-7601	21 – 1 – 76	Anount	Lampegan/Sukabumi	"	Upland
25.	P02-7602	12 – 3 – 76	Central Bodas	Ciparay, Bandung	"	Lowland
26.	P02-7603	23 – 3 – 76	Padi Sebar	"	"	"
27.	P02-7604	23 – 3 – 76	Pelita I/1	"	"	"
28.	P012-7602	24 – 3 – 76	Seratus Malam	Tamanbogo/Lampung	"	Upland
29.	P02-7605	30 – 3 – 76	Padi Sebar	Ciparay/Bandung	Seed	Lowland
30.	P012-7603	23 – 4 – 76	IR-272	Tamanbogo/Lampung	Leaf	Upland
31.	P02-7606	4 – 6 – 76	Jerak	Cipanas, Cibadak, Bogor	"	Lowland
32.	P02-7606	4 – 6 – 76	2230	"	Neck	"
33.	P02-7608	6 – 9 – 76	PB 5	Lampegan/Sukabumi	Leaf	Upland
34.	P02-7609	30 – 12 – 76	Pare Jero	Adapraja, Rajadesa, Ciamis	"	"
35.	P02-7610	31 – 12 – 76	Gama	Rajadesa/Ciamis	"	"
36.	P012-7604	31 – 12 – 76	Anomi	Tamanbogo/Lampung	"	"
37.	p012-7802-5	28 – 7801 – 5	B2153d-Kn-6-3-3	"	"	"
38.	P012-7802-5	28 – 1 – 78	B1734-B-126	"	"	"
39.	P019-7801-1-5	4 – 2 – 78		Ujung Pandang/South Sul.	"	"
40.	P012-7803-1-5	4 – 2 – 78	295 Y-Tb-9	Tamanbogo/Lampung	"	"
41.	P02-7801-1-5	15 – 2 – 78	Sigadis	Muara/Bogor	Leaf	Upland
42.	P012-7804-1	20 – 3 – 78	C 22	Daya Itoh/North Lampung	"	"
43.	P08-7801-1-5	27 – 3 – 78	Dewi Ratih	Agam/West Sumatra	"	Lowland
44.	P012-7805-1-5	27 – 3 – 78	Sigadis	Tamanbogo/Lampung	"	"
45.	P015-7901-5	17 – 2 – 79	Lumut	Kalimantan	"	Green house
46.	P015-7902	17 – 2 – 79	Ceh Mun Nang	Kalimantan	"	"
47.	P02-7903	20 – 3 – 79	IR 30	Bogor	"	
48.	P012-7904	20 – 3 – 79	Bicol	Lampung (Tb)	Neck	
49.	P011-7905	22 – 3 – 79	BPI	P R E	Leaf	Upland
50.	P011-7906	22 – 3 – 79	IR 30	"	"	Lowland
51.	P011-7907	22 – 3 – 79	# 30	"	Neck	"
52	P011-7908	22 – 3 – 79	# 65	"	Leaf	Upland

TABLE 3. (continued)

No.	No code	Date of isolation	Varieties	Location	Part of samples	
53.	P011-7909	22 – 3 – 79	IET 1444	P R E	Leaf	Upland
54.	P011-7910	22 – 3 – 79	# 3	"	Neck	Lowland
55.	P012-7911	23 – 3 – 79	C 22	Lampung	"	Upland
56.	P011-7912	23 – 3 – 79	IR-30	P R E	"	Lowland
57.	P08-7913	23 – 3 – 79	Rambutan	West Sumatra	Leaf	
58.	P011-7914	23 – 3 – 79	Seratus Malam	P R E	"	Upland
59.	P02-8001	24 – 4 – 80	Asahan	Kuningan/West Java	"	Lowland
60.	P02-8002	24 – 4 – 80	Galur	Pacet/Cianjur	"	Upland
61.	P02-8003	8 – 8 – 80	Sigadis	Pacet	"	"
62.	P02-8004	8 – 8 – 80	Sigadis	Muara	"	"
63.	P012-8101	5 – 1 – 81	B295-Tb-9	Tamanbogo	"	"
64.	P08-8102	5 – 1 – 80		Rambatan/West Sumatra	"	"
65.	P08-8103	5 – 1 – 81		Gunung Medan/West-Sumatra	Neck	Lowland
66.	P02-8104	7 – 1 – 81	Sigadis	Muara, Bogor	Leaf	Upland
67.	P08-8105	20 – 1 – 81	9	Payakumbuh	"	"
68.	P08-8106	20 – 1 – 81	10	"	"	"
69.	P08-8107	20 – 1 – 81	11	"	"	"
70.	P02-8108	25 – 1 – 81	Gadis Melati	Ciamis, West Java	"	Lowland
71.	P020-8109		IR-42	Kendari, South East Sul.	"	Upland
72.	P019		Pelita I/1	Maros, South Sulawesi	"	"

Note : P02 West Java
P04 East Java
P05 Yogyakarta
P08 West Sumatra
P011 South Sumatra
P012 Lampung
P015 Central Kalimantan
P019 Central Sulawesi
P020 South Sulawesi

TABLE 4. Reaction of isolates on International and Japanese Differentials, colour of mycelium and sporulation on oat meal agar.

Isolate No.	Reaction on		Colour of Mycelium	Sporulation	Contamination of bacterium
	International	Japanese			
1	ID – 5	102	white	medium	
3	IG – 1		light grey	bad	
4	IF – 1	135	grey	very good	
5	IG – 1	002	white	good	
6	IF – 1	134	grey	very good	
7			white	good	
8	IG – 1	003	grey	medium	
10		102	grey	good	contaminated
13	IG – 1	002	light grey	medium	
14	IG – 1	002	grey	very good	
15	ID – 14	103	grey	very good	
17	ID – 13	103	grey	good	
20	ID – 14	106	light grey	good	
21	IG – 1		white	good	
22	IG – 2	002	grey	very good	
23	IG – 1	003	grey	bad	
24	IG – 2	007	grey	very good	
25		103	grey	good	
26	IG – 1	002	grey	bad	contaminated
27	IC – 1	136	white	bad	
29	IC	103	light grey	bad	contaminated
31			grey	bad	
32	ID – 16	102	grey	very good	
33	ID – 13	103	grey	medium	
34			white on grey	medium	
35	ID – 9	115	grey	very good	
36			white on grey	bad	contaminated
38	ID – 14	103	white on grey	medium	
39	IC – 15	102	white on grey	very good	
40			white on grey	bad	contaminated
41	IG – 2	003	light grey	bad	
42	ID – 9	113	grey	very good	
43	ID – 11	113	white	bad	contaminated
44	IG – 1	002	white on grey	medium	
45	ID – 13	503	grey	very good	
46	IG – 2	003	white	medium	
47	IG – 1	002	white	very good	
48	II	003	white on grey	medium	
49	IG – 2	003	white on grey	medium	
50	IB– 63	103	grey	very good	
52	ID – 15	103	grey	good	
53	ID – 15	103	grey	medium	
54	ID – 15	103	grey	good	
55	IH – 1	002	grey	good	
56	ID – 15	103	grey	very good	

TABLE 4. (continued)

Isolate No.	Reaction on International	Reaction on Japanese	Colour of Mycelium	Sporulation	Contamination of bacterium
57	IH – 1	003	light grey	medium	
58	IG – 2	006	white grey	bad	
59	IF – 1	037	grey	bad	
60	ID – 13	507	light grey	medium	
61	IC – 17	137	white	very good	
62	ID – 13	502	grey	medium	
64	ID – 15	102	white	good	
65	IG – 1	003	white on grey	medium	
66	IG – 1	003	grey	bad	
67	ID – 15	103	grey	good	
68	II	003	white on grey	bad	
69	IH – 1	003	white on grey	very good	
70	IG – 1	006	grey	bad	
71	IG – 1	006	grey	bad	
72	ID – 13	102	grey	medium	

Note : "White on grey" in the colum of colour of mycelium means that grey coloured mycelium grew on oat meal agar at first and then white mycelium covered grey one gradually.

To know the distribution of races, diseased samples should be collected based on the statistically significant sampling method in future. Now in Japan, one diseased leaf and panicle are sampled from 1,000 ha for the identification of physiological race to know the distribution of races.

TABLE 5. Reaction of tested isolates to International Differentials

Variety	International race									
	IB63	IC1	IC15	IC17	ID5	ID9	ID11	ID13	ID14	ID15
Raminad Str. 3	R	R	R	R	R	R	R	R	R	R
Zenith	S	R	R	R	R	R	R	R	R	R
NP 125	R	MS	S	MS	R	R	R	R	R	R
Usen	R	S	S	R	MS	MS	S	S	MS	S
Dular	R	S	R	S	MS	R	R	R	R	R
Kanto 51	R	S	R	S	R	S	S	R	R	R
Sha-tiao-tsao (S)	R	S	R	S	S	S	R	S	S	R
Caloro	S	S	S	S	S	S	S	S	R	S
Isolate No.	50	27	39	61	1	35	43	33	15	52
						42		45	20	53
								60	38	54
								62		56
								72		64
										67

TABLE 5 (continued)

Variety	International Race						Number of isolates which can invade each differentials	% invasion
	ID16	IF1	IG1	IG2	IH1	II		
Raminad Str. 3	R	R	R	R	R	R	0	0
Zenith	R	R	R	R	R	R	1	2.0
Np 125	R	R	R	R	R	R	3	6.0
Usen	S	R	R	R	R	R	21	42.0
Dular	R	R	R	R	R	R	3	6.0
Kanto 51	R	MS	R	R	R	R	8	16.0
Sha-tiao-tsao (S)	R	S	S	S	R	R	35	70.0
Caloro	R	S	S	R	S	R	38	76.0
							Total 50	
Isolate No.	32	4	4	22	55	48		
		6	8	24	57	68		
		59	13	41	69			
			21	46				
			23	49				
			26	58				
			44					
			47					
			65					
			66					
			70					
			71					

2) REACTION OF ISOLATES ON JAPANESE DIFFERENTIAL VARIETIES

The following nine varieties which have a single different major gene for vertical resistance to blast fungus are used for race differentials in Japan. Shin 2: Pi-k^s, Aichiasahi: Pi-a, Ishikarishiroke: Pi-i, Kanto 51 : Pi-k, Tsuyuake : Pi-m, Fukunishiki : Pi-z, Yashiromochi : Pi-ta, Pi No.4; Pi-ta^2, Torido 1 : Pi-z^t.

Collected isolates were inoculated to these Japanese differentials by the spraying method and reactions on these varieties were investigated.

The results obtained are shown in Table 4 and 6. 52 isolates out of 72 isolates collected showed 17 different reaction pattern on Japanese differentials. Those were 002, 003, 006, 007, 037, 102, 103, 106, 113, 115, 134, 135, 136, 137, 502, 503 and 507. 003, 103, 002 and 102 race were predominant among those. There was not an isolate in the tested isolates which could invade Fukunishiki and Pi No. 4.

Isolate No. 50 which was IB-63 also could not invade Fukunishiki. Both Zenith and Fukunishiki have the same resistant gene Pi-z, but reaction of these two varieties for Isolate No. 50 were different. This was the same result as the obtained result by Kobayashi. Number of isolates which could invade each of Japanese differentials was also shown in Table 6. 49 isolates out of 52 isolates identified had pathogenisity to Aichiasahi. 61.5 and 53.8 % of the isolates could invade Shin 2 and Yashiromochi respectively, although only 3 and 4 isolates could invade Toride 1 and Tsuyuake respectively.

Comparative table of identified International race and Japanese race is shown in Table 7. All isolates which belonged to IB, IC and ID group of International race had pathogenisity to Yashiromochi. On the other hand, all isolates of IG, IH and II group could not invade this variety. In the IF group, infection ability to Yashiromochi was different with isolate. All isolate which showed M to S reaction on Toride 1 were included in ID-13 race type.

TABLE 6. Rection of tested isolates to Japanese Differentials

Variety	Japanese Race																	Number of Isolate which can invade each differentials	% Invation
	002	003	006	007	037	102	103	106	113	115	134	135	136	137	502	503	507		
Shin 2	R	S	R	S	S	R	S	R	S	S	R	S	R	S	R	S	S	32	61.5
Aichi asahi	S	S	S	S	S	S	S	S	S	R	R	R	S	S	S	S	S	49	94.3
Ishikari Sairoke	R	R	S	S	S	R	R	S	R	MS	S	S	S	MS	R	R	MS	12	23.1
Kanto 51	R	R	R	R	S	R	R	R	S	S	S	S	S	S	R	R	R	8	15.4
Tsuyuake	R	R	R	R	MS	R	R	R	R	R	MS	MS	S	MS	R	R	R	4	7.7
Fukunishiki	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	0	0
Yashiromochi	R	R	R	R	R	S	S	S	S	S	S	S	S	S	S	S	S	28	53.8
Pi No. 4	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	0	0
Toride 1	R	R	R	R	R	R	R	R	R	R	R	R	R	R	M	M	M	3	5.8
																		Total 52	
Isolate N.	5	8	58	24	59	1	15	20	42	35	6	4	27	61	62	45	60		
	13	23	70			10	25	17	43										
	14	41	71			32	33	29											
	22	48				39	38												
	26	46				64	50												
	44	49				72	53												
	47	57					54												
	55	65					56												
		68					67												
		69																	

TABLE 7. Comparative Table of identified International Race and Japanese Race.

International Race		Japanese race	Isolate No.
IB	63	103	50
IC	1	136	27
	15	102	39
	17	137	61
ID	5	102	1
	9	113	42
		115	35
	11	113	43
	13	102	72
		103	33 17
		502	62
		503	45
		507	60
	14	103	15 38
		106	20
	15	102	64
		103	52 53 54 56 67
	16	102	32
IF	1	037	59
		134	6
		135	4
IG	1	002	5 13 14 26 44 47
		003	8 23 65 66
		006	70 71
	2	002	22
		003	41 46 49
		006	58
		007	24
IH	1	002	55
		003	57 69
II		003	48 68

3) SELECTION OF SOME TEMPORARY STANDARD ISOLATES

Prior to the decision of temporary standard isolates, a preliminary test was conducted to know reactions of leading varieties in Indonesia to six isolates which were identified as IG-1 and 002 type of race by International and Japanese differentials.

Table 8 shows us many interesting informations as described below. The virulence of Isolate No. 44 seems to be weak. S-type lesions did not appear clearly on many varieties tested. So, this isolate is unsuitable for a standard isolate to check the reaction of rice varieties to blast fungus.

Although reactions on Cimandiri, Semeru and Laka were different, Isolate No. 5 and No. 13 seems to belong to the same pathogenic race. These two isolates showed almost same reactions on most of varieties tested. Isolate No. 5 is recommended as the standard of this race because of more clear reaction than Isolate No. 13.

Although reactions on Ayung and Cisadane were different, Isolate No. 47 and No. 26 seems to belong to the same pathogenic race. Isolate No. 26 is recommended as the standard of this race because of more clear reaction than Isolate No. 47.

MR-type lesions were appeared on Klemas, Sumantri and Sirendah by the inoculation of most of isolates. There are posibilities that these three varieties have so-called field resistant genes and these varieties seems to be available as mother varieties for breedings in future. But these varieties shall be eliminated from candidates of differentials for pathogenic races of blast because of their unclear reaction.

Using Isolate No. 5, 26 and 14, varieties tested were divided into 5 groups as shown in Table 8-2.

Table 8. Reaction of leading varieties in Indonesia to IG-1, 002 type isolates

Varieties \ Isolate	47		5		44		13		26		14	
1. Asahan	R	S1/8	R	R	R	R	R	R	S2/8	S3/8	R	R
2. Te-tep	R	R	R	S	R	R	R	R	R	R	R	R
3. *Klemas*	MR2/8	MR1/8	MR1/8	R	R	R	R	MR1/8	MR2/8	MR3/8	R	R
4. PB 42	R	R	R	R	R	R	R	R	R	R	R	R
5. PB 45	R	R	S1/8	R	S2/8	S2/8	S2/7	S3/8	R	R	R	R
6. Cimandiri	S4/8	S2/8	S	S	S2/8	S5/7	R	MR2/8	S6/8	S6/8	R	R
7. Ayung	S1/8	S2/8	S	S7/8	S4/8	S5/8	S4/8	S6/8	S7/8	S	R	R
8. C 22	S	S	S	S	S7/8	S	S5/8	S	S	S	MR	MR
9. *IET 1444*	S4/7	S4/7	S1/4	S1/8	S2/8	S2/8	R	R	S	S	R	R
10. Gemar	S3/8	S3/8	MR1/8	R	S4/8	S3/8	R	R	S6/8	S	R	R
11. Cisadane	S1/8	S3/8	S4/8	S7/8	S5/8	S4/8	S5/8	S5/8	S	S	R	R
12. *GATI*	S3/6	MR3/8	MR1/6	R	S3/8	S1/8	R	R	S2/3	S6/8	R	R
13. Pelita I/1	S5/8	S7/8	S7/8	S	S3/8	S6/8	S2/8	S	S	S	R	R
14. Bicol	R	R	S5/8	S5/8	S6/8	S3/8	S2/8	S3/8	MR4/8	MR3/8	R	MR1/8
15. Serarus malam	S5/7	S6/7	S	S	S5/8	S4/6	S5/8	S7/8	S5/6	S5/6	MR	MR
16. Semeru	R	R	S2/8	S2/8	S	S	S4/8	S	R	R	R	R
17. Kencana	S	S	S	S	S	S	S	S	S	S	S	S
18. Sumantri	MR1/8	MR1/8	MR4/8	MR3/8	R	MR1/8	MR2/8	MR2/8	MR4/8	MR4/8	R	R
19. Sirendah	MR2/8	MR6/8	MR1/8	MR1/8	R	R	R	MR1/8	MR4/8	MR6/8	R	R
20. Laka	R	R	S	S	R	R	R	R	R	R	R	R

Table 8-2. Reaction of leading varieties in Indonesia to IG-1, 002 type isolates

No.	Variety	47	5	44	13	26	14	Temporary Code No.
1.	Asahan	R	R	R	R		R	0?
2.	Te-tep	R	R	R	R	R	R	0
3.	Klemas	MR-R	R	R	R	MR-R	R	0
4.	PB 42	R	R	R	R	R	R	0
5.	PB 45	R	R			R	R	0?
6.	Cimandiri		S		MR-R	S	R	3
7	Ayung	R	S	S	S	S	R	3
8	C-22	S	S	S	S	S	MR	3
9	IFT 1444	S	R		R	S	R	2
10	Gemar		R		R	S	R	2
11	Cisadane		S	S	S	S	R	3
12	Gati		R		R	S	R	2
13	Pelita I/1	S	S	S		S	R	3
14	Bicol	R	S	S		MR	R	1
15	Seratus Malam	S	S	S	S	S	MR	3
16	Semeru	R		S	S	R	R	1?
17	Kencana	S	S	S	S	S	S	7
18	Sumantri	MR-R	MR	R	MR-R	MR	R	0
19	Siredah	MR-R	MR-R	R	R	MR	R	0
20	Laka	R	S	R	R	R	R	1
Code No.			1			2	4	

Code No. 0 ; Asahan, Tetep, Klemas, PB 42, PB 45, Sumantri and Sirendah. These varieties were not attacked by any of isolates.

Code No. 1 ; Bicol, Semeru and Laka. Only Isolate No. 5 could attack these varieties. Laka will be recommended as a representative in this group.

Code No. 2 ; IET 1444, Gemar and Gati. Isolate No. No. 26 could attack these varieties. IET 1444 or Gamer will be a representative of this group.

Code No. 3 ; Cimandiri, Ayung, C-22, Cisadane, Pelita I/1 and Seratus Malam. Isolate No. 5 and 26 could attack these varieties. Seratus Malam or C-22 will be a representative of this group.

Code No. 7 ; Kencana were attacked by all of isolates tested.

Isolate No. 44 seems to have wider host range than other isolates, so if we can find out a isolate which belongs same type and has higher virulence, that isolate will become one of standard isolate.

As described above, even the isolates which belonged the same race group based on reactions on International and Japanese differentials showed different reactions on leading varieties in Indonesia. These results seemed to indicate that Indonesian varieties have some unknown resistant genes against blast fungus and these genes can not be detected by International and Japanese differentials. So we can not select standard isolates for the selection of the Indonesian differentials by only reactions of isolates on International and Japanese differentials.

Next 8 isolates were selected as temporary standard isolates for the grouping of Indonesian varieties based on the results of mycelial growth and sporulation on the oat meal agar, frequency of isolation and reactions on International and Japanese differentials.

Isolate No. 60 : This isolate has the pathogenisity to Toride 1

Isolate No. 66 : One of predominant races in Indonesia

Isolate No. 64 : One of predominant races in Indonesia

Isolate No. 15 : One of predominant races in Indonesia

Isolate No. 6 : This isolate can invade so-called Chinese type varieties

Isolate No. 24 : This isolate has the capability to attack Ishicarishiroke

Isolate No. 39 : This isolate belongs to IC group

Isolate No. 47 : One of predominant races in Indonesia

(3) GROUPING OF INDONESIAN RICE VARIETIES BASED ON REACTION TO THE TEMPORARY STANDARD ISOLATES

Reiichi YOSHINO* and Otjim SUMANTRI**

64 Indonesian varieties were inoculated with eight temporary standard isolates as shown in Table 9. Among 64 varieties, from variety No. 48 to 60 were introduced from IRRI and others were Indonesian local varieties and those of released from CRIA.

46 among 64 varieties were ascertained about their reactions to 8 temporary standard isolates and divided into 24 groups (Table 9-3, Fig. 1). In Fig. 1, the tested isolates were placed in a row in order of width of their host range, that is, Isolate No. 24 was the widest and Isolate No. 6 was the narrowest. Varieties released from IRRI were separated to only 4 groups and some of new varieties released from CRIA such as Bathara, Arimbi, Jelita and Syntha were belonged to the same group while most of local varieties composed one group by one variety.

About isolates tested, Isolate No. 60 must be checked again about its pathogenisity to International and Japanese differentials because of its weaker pathogenisity to Indonesian varieties than expected. Isolate No. 47 shall be eliminated from candidates of standard isolates by the reason of the result of the discussion on Table 8. Isolate No. 5 and 26 shall be added to candidates of standard newly. Isolate No. 66 must be examined again about its pathogenisity to leading varieties with other 003 type isolates. After these inoculation tests, newly representative races must be selected.

Anyway, more than three years will be needed to establish the original set of differentials for rice blast races in this country as other country needed before. I think that the most basically needful thing to proceed this work further is to know what are important varieties for the actual cultivation and breeding in future. About isolates used. I have already written some thing in other sheet of this paper. Besides those, I think we need to find out some isolates which can attack PB-38. We know PB-38 has a already invaded by blast disease in Indonesia though all isolates used in Table 9 could not attack this variety.

We must remember that the distribution of pathogenic races would change with varieties cultivated. If some variety become popular in cultivation by the reason of having vertical resistance to predominant races, new races which have affinity to this variety would appear within a few years and the breakdown of this variety would occur. So, I think varieties which have horizontal resistance to any races will be better for the actual cultivation of rice if it is possible, And some ecological studies on blast disease will be also needed in future. The character of blast fungus in this country seems to be different from the fungus in Japan. For instance, Sporulation is best in the temperature 25 to 28°C in Japan and sporulation ability decreases rapidly above 30°C. But in Indonesia, sporulation seems to be good even at the temperature of 32°C. At what temperature can the blast fungus sporulatest in Indonesia ? Some studies must be carried out on this question. And how does the strong rainfall affect the development of blast disease in a field shall be also studied. In spite of the optimal temperature for blast disease, the disease incidence of blast in lowland fields in not so high. I think there are many interesting problems to be clarified in this country from the ecological sight of view.

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Table 9. Reaction of Indonesian varieties to the temporary representative isolates.

Isolate No.		60	66	64	15	6	24	39	47
International Race		ID-13	IG-1	ID-15	ID-14	IF-1	IG-2	IC-15	IG-1
No.	Japanese Race / Variety	507	003	102	103	134	007	102	002
1	Sirendah	3/3S	R^h	MS	R^h	R^h	R	R^h	2/2S
2	Cempo Turi	S	6/8S	S	R^h	1/8S	S	S	S
3	Papah Aren	S	R	S	M–S	S	S	6/7S	R
4	Genjah Lampung	S	R^h	S	R^h	3/7S	3/8S	R^h	R^h
5	Urang Urangan	S	R^h	R	S	R	S	R^h	R^h
6	Rantai Emas	R	R^h	R	R^h	R^h	S	R^h	1/8S
7	Palembang Darat	S	R^h	5/7S	R^h	2/8S	4/6S	R^h	R
8	Rembang	S	1/8MR	R^h	3/7S	S	S	R^h	R
9	Pulut Bandrahuja	S	1/8S	5/8S	S	R^h	S	R^h	1/8S
10	Bathara	R	S	S	R^h	R^h	S	S	S
11	Cina	S	R^h	R	4/8S	R^h	S	R^h	R^h
12	Cahaya	S	S	S	R^h	R^h	2/8S	4/8S	6/7S
13	Padi Buluh	R	R	S	S	R	2/2S	R^h	R^h
14	Belulung	S	3/8M–S	S	R	R	MS	S	R^h
15	Klemas	MR	R^h	R	R^h	2/6M	R^h	R^h	R^h
16	Kencana Bali	S	S	S	S	S	S	S	S
17	Semariti	M	R^h	R	R^h	5/8S	R	R^h	R
18	Kasturi	S	R^h	S	R^h	M-MR	7/8S	2/8S	6/8S
19	Java 14	S	R^h	S	3/8MR	R	S	M	S
20	Malaman	S	R^h	S	S	R	S	R	3/8S
21	Kencana	S	S	S	S	S	S	S	S
22	Seratus malam	S	MS	MR	S	S	S	R^h	7/8S
23	Gata	R^h	4/8S	S	R	R^h	S	R^h	1/8S
24	Citarum	M	5/7S	S	4/8S	R	S	S	3/8S
25	Serayu	S	5/8MS	S	R^h	S	S	R^h	3/8MR
26	C4–63	R^h	1/8MR	4/8S	R^h	R^h	MS	R^h	1/8S
27	Bengawan	R	4/8S	MR	R^h	R^h	R	R^h	MS
28	Pelita 1/2	MR	6/8S	S	R^h	R^h	S	4/8M-S	6/8S
29	Dewi Tara	MR	4/8S	S	R^h	R^h	S	3/8S	7/8MS
30	Remaja	R	S	S	R^h	R^h	S	R^h	S
31	Dara	R	5/8S	S	R^h	R^h	S	3/8S	2/8S
32	Dewi Ratih	R^h	S	S	R^h	R^h	S	R^h	6/8S
33	Bicol (BPT-76)	S	1/8S	S	1/8S	R^h	MS	R^h	3/8S
34	Brantas	1/8S	2/8S	S	R^h	R^h	3/8M-S	R^h	1/8S
35	B29j-Tb-9	R	4/8S	S	R	5/8M	4/8MS	6/8MS	3/8M
36	Laka	R^h	R^h	7/8MS-S	R^h	R^h	R^h	R^h	R^h
37	C22	S	S	R	R^h	3/8S	S	R^h	S
38	Gati	1/8S	2/5S	S	R^h	R^h	2/8S	R^h	2/8S
39	Ayung	R	4/7M-S	7/8S	R^h	R^h	1/8S	5/8S	1/8S
40	Asahan	R	R^h	1/8S	R^h	R^h	R^h	R^h	R^h
41	Cisadane	R^h	1/8S	S	R^h	R^h	2/8S	1/8S	1/8S
42	Pelita I/1	R	4/6S	S	R^h	R^h	S	6/8S	3/8S
43	Semeru	R	R^h	R	R^h	M	S	R^h	R^h
44	Cimandiri	R	3/8M-S	6/7S	R^h	R^h	4/8S	1/8S	1/8S
45	Gemar	R	4/7S	S	R^h	R^h	S	R^h	5/7S
46	IET 1444	S	1/7S	S	1/8S	1/8S	S	R^h	6/8S
47	Sigadis	R^h	S	S	R^h	R^h	MS	1/8S	4/7S
48	Lagos	R	R	S	1/8S	R	R	R	R^h
49	PB 5	S	R^h	3/8M	R	R^h	S	R^h	R^h
50	PB 8	R	S	S	R^h	R^h	S	R^h	4/5S

TABLE 9. (continued)

Isolate No.		60	66	64	15	6	24	39	47
International Race		ID-13	IG-1	ID-15	ID-14	IF-1	IG-2	IC-15	IG-1
No.	Japanese Race Variety	507	003	102	103	134	007	102	002
51	PB 20	R^h	2/8S	S	R^h	R^h	S	R^h	R
52	PB 26	R^h	2/8MS	S	R^h	R^h	S	R^h	R
53	PB 28	R^h	1/8S	6/8S	R^h	R^h	5/8MS	R^h	1/8S
54	PB 30	R^h	S	S	R	R^h	S	R^h	5/8S
55	PB 32	R^h	R^h	4/8M	R^h	R^h	S	R^h	R^h
56	PB 34	R^h	R^h	R^h	R^h	R	5/8S	R^h	R^h
57	PB 36	R^h	R^h	1/8S	R^h	R^h	S	R^h	R^h
58	PB 38	R^h	R^h	R	1/8M	R^h	R	R^h	R^h
59	PB 42	MR	R^h	2/8S	R^h	R^h	MS	R^h	R^h
60	PB 45	MR	R^h	1/8S	R^h	R^h	S	R^h	R^h
61	Arimbi	R	S	S	R	R^h	S	S	S
62	Jelita	R	S	S	R	R^h	S	S	S
63	Syntha	R	S	S	R^h	R^h	S	S	S
64	Adil	R	S	S	R^h	R^h	S	R	3/8S

Note : 2/8 S means that 2 seedlings showed susceptible reactions and the other 6 seedlings showed resistant reactions.

TABLE 9–2 Reaction of Indonesian varieties to the temporary standard isolates.

Isolate No.		24	64	66	47	60	39	15	6	Temporary
International Race		IG-2	ID-15	IG-1	IG-1	ID-13	IC-15	ID-14	IF-1	Code NO.
Japanese Race		007	102	003	002	507	102	103	134	of
No.	Variety									Variety
1	Sirendah	R	MS	R	MR	S	R	R	R	022
2	Cempo Turi	S	S	S	S	S	S	R	R	077
3	Papah Aren	S	S	R	R	S	S	S	S	363
4	Genjah Lampung		S	R	R	S	R	R		
5	Urang Uragan	S	R	R	R	S	R	S	R	121
6	Rantai Emas	S	R	R	R	R	R	R	R	001
7	Palembang Darat	S	S	R	R	S	R	R	R	023
8	Rembang	S	R	R	R	S	R		S	
9	Pulut Bandrahuja	S	S	R	R	S	R	S	R	123
10	Bathara	S	S	S	S	R	S	R	R	057
11	Cina	S	R	R	R	S	R		R	
12	Cahaya	R	S	S	S	S		R	R	
13	Padi Buluh	S	S	R	R	R	R	S	R	103
14	Belulung	MS	S		R	S	S	R	R	
15	Klemas	R	R	R	R	MR	R	R	R?	000?
16	Kencana Bali	S	S	S	S	S	S	S	S	377
17	Semariti	R	R	R	R	M	R	R	S	220
18	Kasturi	S	S	R	S	S	R	R	MR	033
19	Java 14	S	S	R	S	S	M	R	R	073
20	Malaman	S	S	R		S	R	S	R	
21	Kencana	S	S	S	S	S	S	S	S	377
22	Seratus malam	S	MR	MS	S	S	R	S	S	335
23	Gata	S	S		R	R	R	R	R	
24	Citarum	S	S	S		M	S		R	
25	Serayu	S	S	S		S	R	R	S	
26	C4–63	MS		R	R	R	R	R	R	
27	Bengawan	R	MR		MS	R	R	R	R	
28	Pelita I/2	S	S	S	S	MR		R	R	
29	Dewi Tara	S	S		MS	MR		R	R	
30	Remaja	S	S	S	S	R	R	R	R	017
31	Dara	S	S	S	R	R		R	R	
32	Dewi Ratih	S	S	S	S	R	R	R	R	017
33	Bicol	MS	S	R	R	S	R	R	R	043
34	Brantas		S	R	R	R	R	R	R	
35	B29–j–Tb–9		S			R	S	R	S	
36	Laka	R	S	R	R	R	R	R	R	002
37	C–22	S	R	S	S	S	R	R	R	035
38	Gati	R	S	S	R	R	R	R	R	006
39	Ayung	R	S	R	R	R	S	R	R	042
40	Asahan	R	R	R	R	R	R	R	R	000
41	Cisadane	R	S	S	R	R	R	R	R	006
42	Pelita I/1	S	S	S	S	R	S	R	R	057
43	Semeru	S	R	R	R	R	R	M	S	301
44	Cimandiri	S	S	S	R	R	R	R	R	007
45	Gemar	S	S	S	S	R	R	R	R	017
46	IET 1444	S	S	S	S	S	R	S	R	137
47	Sigadis	MS	S	S	S	R	R	R	R	017
48	Lagos	R	S	R	R	R	R	R	R	002
49	PB 5	S		R	R	S	R	R	R	
50	PB 8	S	S	S	S	R	R	R	R	017

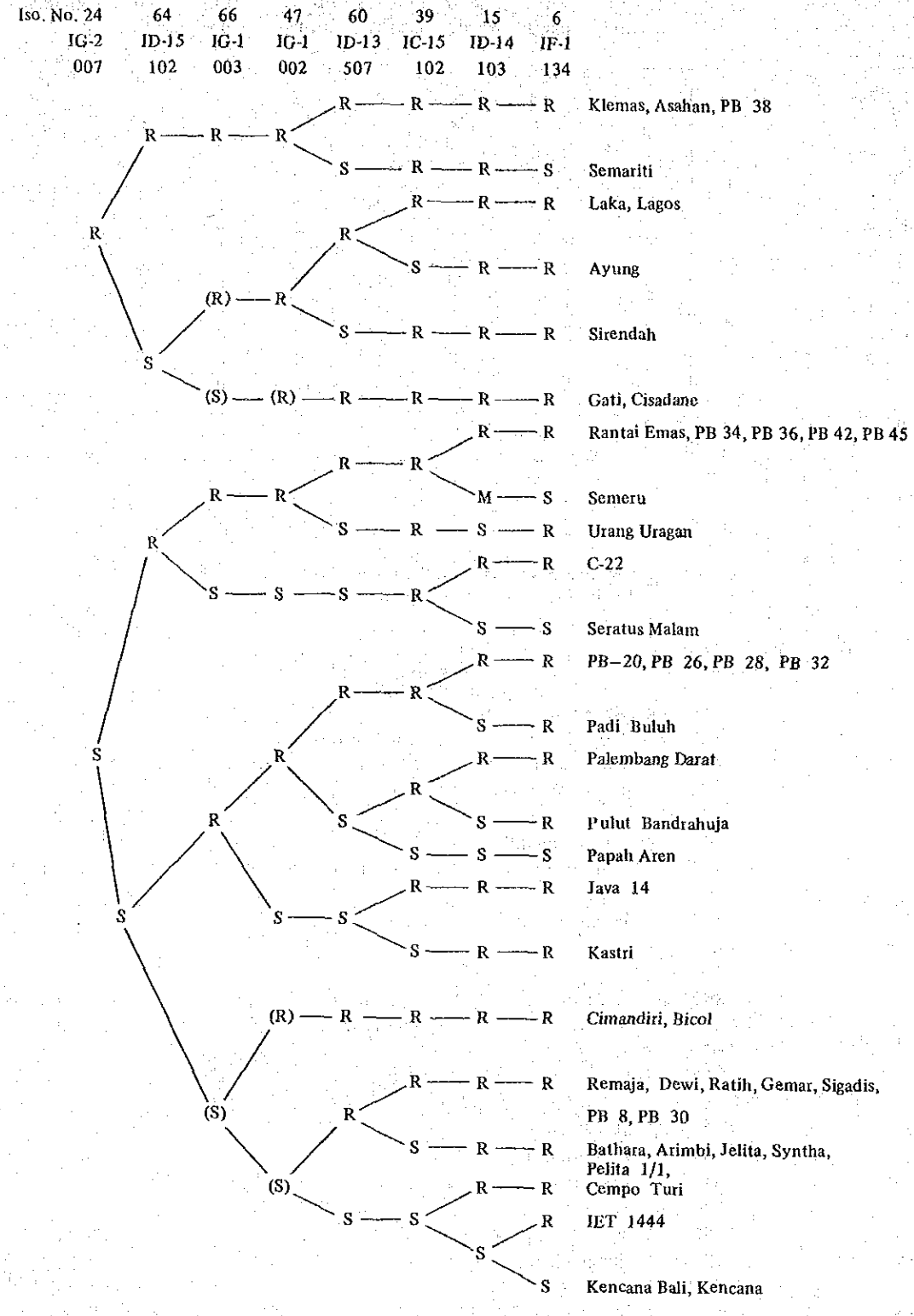
TABLE 9.–2 (continued)

Isolate No.	24	64	66	47	60	39	15	6	Temporary
International Race	IG-2	ID-15	IG-1	IG-1	ID-13	IC-15	ID-14	IF-1	Code NO.
Japanese Race	007	102	003	002	507	102	103	134	of
No. Variety									Variety
51 PB 20	S	S	R	R	R	R	R	R	003
52 PB 26	S	S	R	R	R	R	R	R	003
53 PB 28	S	M	R	R	R	R	R	R	003
54 PB 30	S	S	S	S	R	R	R	R	017
55 PB 32	S	M	R	R	R	R	R	R	003
56 PB 34	S	R	R	R	R	R	R	R	001
57 PB 36	S	R	R	R	R	R	R	R	001
58 PB 38	R	R	R	R	R	R	R	R	000
59 PB 42	MS	R	R	R	MR	R	R	R	001
60 PB45	S	R	R	R	MR	R	R	R	001
61 Arimbi	S	S	S	S	R	S	R	R	057
62 Jelita	S	S	S	S	R	S	R	R	057
63 Syntha	S	S	S	S	R	S	R	R	057
64 Adil	S	S	S		R	R	R	R	

TABLE 9–3 Grouping of Indonesian varieties based on the reactions to the temporary standard isolates

Temporary No. of variety	Variety
000	Klemas, Asahan, PB 38
001	Rantai Emas, PB 34, PB36, PB42, PB45
002	Laka, Lagos
003	PB 20, PB 26, PB 28, PB 32
006	Gati, Cisadane
007	Cimandiri, Bicol
017	Remaja, Dewi Ratih, Gemar, Sigadis, PB 8, PB30
022	Siredah
023	Palembang Darat
033	Kastri
035	C–22
042	Ayung
057	Bathara, Arimbi, Jelita, Syntha, Pelita I/1
073	Java 14
077	Cemp Turi
103	Padi Buluh
121	Urang Uragan
123	Pulut Bandrahuja
177	IET 1444
220	Semariti
301	Semeru
335	Seratus Malam
363	Papah Aren
377	Kencana Bali, Kencana

Fig. 1 Grouping of Indonesian varieties based on reactions to temporary standard isolates



( ) *means unstability of reactions.*

(4) OBSERVATION, ISOLATION AND INOCULATION TEST OF PYRICULARIA SP. ON WEEDS

Otjim SUMANTRI* and Reiichi YOSHINO**

During my staying in Indonesia, leaf blast diseases on gramineaceae plants were observed, and diseased plants were sampled. These sampled plants were identified their species names by the Herbarium Bogoriens. The names of diseased plants and locations are as follows.

1). *Panicum repens* L : Leaf blast on this grass were observed everywhere I visited namely Sukamandi, Lembang, Lampung, Palembang, Pacet, Sukabumi, Bogor etc.

2). *Digitaria sanguinalis* L. (Crab grass) :
Leaf blast on this grass could not be observed so widely. I could observed only in Sukamandi.

3). *Leersia hexandra* Swartz :
The occurrence of leaf blast on this plant in Lampung Province was confirmed by Mr. Otjim Sumantri and me and diseased leaves of this plant were sampled from Tamanbogo and Bandarjaya. In other places I could not observe leaf blast occurrence on this plant.

Among these, monoconidial isolation was conducted from a leaf blast lesion on *Leersia hexandra* which was sampled in Bandarjaya. To make clear whether this isolate has the pathogenicity to rice plants or not, the isolate was inoculated to International differentials, Japanese differentials and some Indonesian varieties.

The results are shown in Table 10. The isolate from *Leersia hexandra* had the pathogenicity to only Kencana in varieties tested. Large and clear pG-type lesions appeared on leaves of Kencana 4 days after inoculation, though small brown spots or no lesion appeared on the other varieties.

I think this simple result is very important. Sawada,, K. (1917), Giatgong, P. (1961) and Siwasin, C *et al.*, (1971) have already studied on pathogenicity of *Pyricularia* sp. on *Leersia hexandra* to rice plants, but it was reported that *Pyricularia* sp. on *Leersia hexandra* did not show the pathogenicity to rice plants in these studies. So this is the first report in the world that showed *Pyricularia* sp. on *Leersia hexandra* has pathogenicity to rice plants, though only one variety Kencana was infected by this fungus. Results of tests on the pathogenicity of the reisolated isolate from Kencana to *Leersia hexandra* and pathogenicity to panicles of rice plants should be added to this result when you will officially publish this result. I hope you will develope this study further and clarify the relation between blast disease on rice and those on weeds after this. There is a possibility that blast diseases on weeds are inoculum souces for panicle blast on rice plants.

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TABLE 10. Reaction of International differentials, Japanese differentials and some Indonesian varieties to the blast fungus isolated from *Leersia hexandra* Swartz

International differentials	Reaction	Japanese differentials	Reaction	Indonesian varieties	Reaction
Raminad Str. 3	R^h	Shin 2	R	Gati	R
Zenith	R^h	Aichi asahi	R^h	Pelita I/1	R^h
NP 125	R^h	Ishikari shiroke	R	Kencana	S
Usen	R^h	Kanto 51	R^h	Syntha	R^h
Dular	R	Tsuyuake	R^h	Sigadis	R
Kanto 51	R^h	Fukunishiki	R^h	Pelita I/2	R^h
Sha-Tiao-Tsao (S)	R	Yashiromochi	R^h		
Caloro	R	Pi No. 4	R^h		
		Toride 1	R^h		

Synbols : R^h : No. symptoms
R : Brown spot are predominant
S : pG-type lesion are predominant

摘　　要

インドネシアにおけるイネいもち病菌レース判別品種体系の確立

吉野嶺一

１９７３～１９８１年にインドネシア各地の罹病イネから単胞子分離したいもち病菌７２菌株を常法により，国際判別品種および日本判別品種に接種して，各菌株の病原性を検定すると共に，上記検定菌株のうち胞子形成が良好なレースの異なる８菌株を，インドネシアで現在栽培されている品種および在来品種計６４品種に接種し，供試菌株に対する反応の違いにより品種を群別しようとした。

国際判別品種に対しては，供試菌株のうち５０菌株で病原性が明らかとなり，レースとしてはIB−63, IC−1, IC−15, ID−5, ID−9, ID−11, ID−13, ID−14, ID−15, ID−16, IF−1, IG−1, IG−2, IH−1, IIが存在し，このうち*IG−1*, *ID−15*, *IG−2*, *ID−13*の頻度が高かった。また，７６％の菌株がCaloroに対して病原性を示し，Shatiao−tsao(S), Usenに対してそれぞれ７０，４２％の菌株が病原性を示した。Raminad Str．３を侵し得る菌株のなく，Zenithを侵し得る菌株は１菌株のみであった。国際判別品種に病原性を示さないIIレースが２菌株存在したがこれらはいずれも日本判別品種のうち新２号および愛知旭に病原性を持っていた。

日本判別品種に対しては，５２菌株の病原性が明らかとなり，レースとしては002, 003, 006, 007, 037, 102, 103, 106, 113, 115, 134, 135, 136, 137, 502, 503, 507が存在し，このうち003, 103, 002, 102レースの頻度が高まった。また，９４.３％の菌株が愛知旭に対して病原性を持ち，新２号，ヤシロモチに対してはそれぞれ61.5，58.8％の菌株が病原性を持っていた。フクニシキ，Pi№4を侵し得る菌株は見出されなかった。

IG−1, 002レースに属する６菌株を用いて，インドネシアで現在栽培されている主要２０種に接種した結果，病原力のいちじるしく弱い１菌株を除いた５菌株に対する反応から，これら２０品種は，どの菌株にも侵されないもの，№５および№１３菌のみに侵されるもの，№２６および№４７菌のみに侵されるもの，前４菌株に侵されるもの，№１４菌を含めた５菌株すべてに侵されるものの５群に群別され，国際判別品種あるいは日本判別品種によっては検出できないような抵抗性因子がインドネシアの品種には含まれていることが明らかとなった。したがって，今後，分離菌株のインドネシア品種への接種をくり返し行うことによって独自の判別品種体系を作り上げる必要がある。

仮りの代表菌株として，胞子形成良好な菌株の中からできるだけレースの異なる８菌株を選んで，インドネシア６４品種に接種した結果，反応の不安定な１７品種を除いた４７品種が２４のグループに群別された。IRRIで育成された品種および近年インドネシアで育成された品種では，比較的数少ないグループに品種が群別されたが，在来品種は単独で１グループを形成するものが多いように考えられた。なお，Klemas, Asaham, PB−38は供試８菌株に対して抵抗性を示したが，現地ではこれらの品種でも葉いもちの発生が認められているので，これらの品種を侵し得るような菌株をさがし，代表菌株の中に入れるようにする必要があるものと考えられる。

現地調査に際しては，インドネシアにおける雑草のいもち病について調査したが，メヒシバ，・*Panicum repens*・*Leersia hexandra*（タイワンアシカキ）に葉いもちが発生しているのが認められた。このうち*Leersia hexandra*病斑から単胞子分離した菌株をイネを接種したところ，国際判別品種，・日本判別品種・Pelit $^{J}/_{1}$・Pelita $^{J}/_{2}$・Sigadis・Gati・SythaではR反応であったが，Kencanaだけは S反応を示した。