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STUDIES ON THE INHERITANCE OF RESISTANCE
TO RICE BLIGHT DISEASE

Results of Basic Breeding Tests, published
by Genetics Laboratory No. 1, Genetics
Section, Department of Physiology and Ge-
netics, National Institute of Agricultural
Sciences, Japan, 1962

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and
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I. Test for Disease Resistance

Last year more than 100 varieties of rice, including domestic and foreign varieties, were tested for resistance to disease. This year 100 different varieties were tested for disease resistance, including the disease resistance of various strains of rice.

Experimental Materials and Method

The different varieties of rice used in these tests included primarily the main disease resistant strains used for the breeding of disease resistant varieties by the Chinese Agricultural Experimental Station, some varieties possessed by the Agricultural Research Laboratory, and other varieties and strains received from the Fujisaka Testing Station and other organizations.

Of these varieties, those received from the Chinese Agricultural Experimental Station were already known to be disease resistant, and therefore we conducted tests on these particular varieties with respect to their resistance to a wider range of pathogens. The varieties of rice obtained from the Fujisaka Testing Station were either varieties being developed there or which had already been developed there.

The strains of fungi used were the same as those used in the previous year, that is, a variety of fungi, which could be classified into seven strains, were used:

P-2b	53-33	A1 72	Kita 1	54-20	54-04	Ine 168
T-2	C1	C3	N1	N2	Unknown	N4

Here the correspondence between the different fungi strains and corresponding pathogenic fungi groups are shown. This correspondence is based on rice variety reaction to the injection method of inoculation, whereas pathogenic grouping is normally determined by the spraying method.

The injection method of inoculation and the method of handling the plants after inoculation were the same as the methods used in the previous year of testing. Some change was made however in the method of judging the results, that is to say, in using many foreign varieties of rice, it was found that the number of spots more or less indicated characteristically a particular combination of rice variety and fungus type, so that spot count was added to the basic criteria used in last year's testing. (It should be noted that last year's results hardly need to be revised because of the addition of spot count to the criteria.)

Although it was not mentioned in last year's report, it should be noted that 16 individual plant specimens were used for each test combining a variety and type of fungus.

Table 1. Criteria

I.	More than two-thirds of individual organisms lacking in spots.....		R ^h
II.	Less than two-thirds of individuals spotless:		
	1. Mean spot count in remaining individual plants is less than 1.5.....		R ^h
	2. Mean spot count in remaining individual plants is more than 1.5.		
	A. Mode is in b spots.		
	a. $b \geq 2 (bg + bG + pG)$		R
	b. $(bg + bG + pG) \leq b < 2$ $(bg + bG + pG)$	α^* β^*	R MR
	c. $b < (bg + bG + pG)$	α β	MR M
	B. Mode is in bg spots		
	a. $(b + bg) \geq (bG + pG)$	α β	MR M
	b. $(b + bg) < (bG + pG)$	α β	MR MS

C. Mode is in bG spots		
a. $(b + bg) \geq (bG + pG)$	α	MR
	β	M
b. $(b + bg) < (bG + pG)$	α	M
	β	MS
D. Mode is in pG spots		
a. $(b + bg + bG) \geq pG$	α	M
	β	MS
b. $(b + bg + bG) < pG$	α	MS
	β	S

Remarks: α * means average spot count less than 7.
 β * means average spot count more than 7.

(If the extremity from the diseased part of the plant had withered so that a spot count could not be made, the spot count for that extremity was taken to be 10.)

The spot count criteria for determining disease resistance is significant in the case of judging disease resistant strains, employing many individual plants, but it is not particularly effective in judging individual plant characteristics since there is so much variance from plant to plant in spot count.

The dates of planting, inoculation, and examination in the current series of tests are given in Table 29 near the end of this report.

Experimental Results

The results of the experiment are shown in Table 2. It should be noted that the disease resistant characteristics of foreign rice varieties were complex and that definitive results and classification according to degree of disease resistance for these varieties could not be determined with a single series of tests, but the tests were sufficient to show general trends in the disease resistance characteristics of these varieties.

Table 2.

No. of experiment	Variety	Fungus Strain										Country of Origin	
		P-26	53-33	A1 72	Kita 1	54-20	54-04	Ine 168					
Exp. 2-1	Takara	S	S	R	S	S	S	S	S	S	R	S	Japan
	Shinyamabuki	MS	S	S	S	S	S	S	S	M	S	S	"
	Kaori	S	S	R	S	S	S	S	S	S	R	R	"
	Tokai No. 9	MS	S	R	S	S	S	S	S	M	R	R	"
	Sanin No. 45	MS	S	S	S	S	S	S	S	S	S	S	"
Sachivatari	S	S	S	S	S	S	S	S	S	S	S	S	"
Exp. 2-2	Norin No. 27	S	S	R	S	S	S	S	S	S	R	S	Japan
	Kanto No. 60	S	S	S	S	S	S	S	S	S	S	S	"
	Tokai No. 11	S	S	S	S	S	S	S	S	S	S	S	"
	Wase Aikoku No. 3	S	S	S	S	S	S	S	S	S	S	S	"
	Ginbozu chusei	S	S	S	S	S	S	S	S	MS	S	S	"
Exp. 2-3	P1 No. 1	MS	S	R	M	M	M	M	M	R	R	R	Japan
	P1 No. 2	S	S	R	M	M	M	M	M	M	R	R	"
	P1 No. 3	MS	S	MR	R	R	MR	MR	MR	MR	MS	MS	"
	P1 No. 4	S	S	MR	R	R	MR	MR	MR	MR	MS	MS	"
	P1 No. 5	S	MS	M	MR	M	M	M	M	MR	M	M	"
Tadukan	MR	MS	R	MR	M	M	M	M	M	MR	MR	Philippines	
Exp. 2-5	Mikava Nishiki	S	S	R	S	S	S	S	S	S	R	R	Japan
	Aichi Wase No. 1	S	S	S	S	S	S	S	S	S	S	S	"
	Chusei Hcnen	S	S	R	S	S	S	S	S	S	R	R	"
	Tasensho	MS	S	S	S	S	S	S	S	S	S	S	"
	Takane Asahi	S	S	R	S	S	S	S	S	MS	R	R	"
Shirosebon	S	S	R	S	S	S	S	S	S	S	R	R	"

No. of experiment	Variety	Fungus Strain										Country of Origin			
		P-2b	53-33	Al 72	Kita 1	54-20	54-04	Ine 168							
Exp. 2-6	Shinju	S	S	S	S	S	S	S	S	S	S*	M	S*	S*	Japan X
	Wase Asahi No. 2	S	S	S*	S	S	S	S	S	S	S	S*	S	S	" X
	Togo	S	S	S	S	S	S	S	S	S	S	M	S	S	"
	Koburyo Miyako	S	S	S	S	S	S	S	S	S	S	S	S	S	"
	Senichi	S	S	S	S	S	S	S	S	S	S	S	S	S	"
	North China T'ai-mi	M*	S*	R	MR*	R	R	R	China X						
Exp. 2-7	ADT 10	R	MS	R	R ^h	MR	R ^h	R ^h	India 0						
	Sigadik	R ^h	R ^h	R ^h	Indonesia 0										
	Remadja	R ^h	MR	R ^h	R	MR	MR	MR	MR	MR	R	R	R	R	" 0
	Biiji Liman	M	S	M	MR	MS	MS	MS	MS	M	M	M	MS	MS	Malay 0
	Bengawan	R	M	R	R	M	M	M	M	R	R	R	R	R	Indonesia 0
	Engkateg	R ^h	R ^h	R ^h	Malay 0										
Exp. 2-8	Latisail	M	M	M	R	R	M	M	M	M	MR	MR	M	M	India 0
	Tjina	R ^h	MR	R ^h	MR	R ^h	R ^h	Indonesia 0							
	Moktan	MR	MR	MS	R ^h	MR	R	R	Malay 0						
	Pahit	M	MS	M	MS	MS	MS	MS	MS	M	M	M	MS	MS	" 0
	Kogyoku	S	S	R+S	S	S	S	S	S	R+S	S	S	S	R+S	Japan 0
	Asakaze	S	S	R	S	S	S	S	S	R	S	S	S	R	" 0
Exp. 2-12	Shimokita	S	S	R	M	M	M	M	M	M	M	M	R	R	Japan Δ
	Fu-strain mochi	R	S	S	R	R	R ^h	R ^h	MR	" Δ					
	Rice No. 57	MR	S	MS	S	S	MR	MR	MR	MR	R ^h	R ^h	MR	MR	" Δ
	Fu-strain No. 59	S	S	R	S	S	S	S	S	S	S	S	S	R ^h	" Δ
	Fujiminori	M	M	MR	M	M	M	M	M	MR	M	M	M	R ^h	" Δ
	Fu-strain No. 67	M+S	M+S	R	M+S	M+S	R	" Δ							
440 (Fujisaka breed)	M+S	M+S	R	M+S	R	" Δ									

No. of ex- periment	Variety	Fungus Strain										Country of Origin	
		P-2b	53-33	A1 72	Kita 1	54-20	54-04	Ine 168					
Exp. 2-14	Tep Saigon 229	S	MS	MR	M	MS	M	R	R ^h	M	R	R	Viet Nam
	Bau 157	MS	MS	R ^h	M	M	M	R	R ^h	M	R	R	"
	Nang ech	M	MR	R ^h	M	S	M	R	R ^h	M	R ^h	R ^h	"
	Giao eao 89-B	M	M	M	R	MS	M	M	R	M	MS	R	"
	Soc. do	S	S	R ^h	M	MS	M	M	R	M	R	R	"
Mong toy trung B	S	S	R ^h	M	S	M	M	R	M	M	R	"	
Exp. 2-17	539 (Fujisaka breed)	R	M	R ^h	R ^h	R ^h	R ^h	R ^h	R ^h	R ^h	MR	MR	Japan Δ
	553	R	MS	R ^h	R ^h	MR	R ^h	MR	MR	R ^h	MR	MR	" Δ
	563	R	S	M	MR	R ^h	R ^h	R ^h	R ^h	R ^h	R ^h	R ^h	" Δ
	1233	MR+S	S	MR+S	M+S	MR+S	R ^h +MS	R+S	R+S	R+S	R+S	R+S	" Δ
	Giong Chiem 351	M	M	R ^h	M	M	M	M	R	M	R	R	Viet Nam
	Cau Phuxuyen	M	MS	R ^h	MR	M	M	M	R	M	R	R	"
Exp. 2-19	Lead Rice	MR	R ^h	MR	R ^h	M	R ^h	M	R ^h	R	M	M	Burma
	Badshabhog	MR	MR	MR	R ^h	R ^h	R ^h	R ^h	R ^h	R ^h	R ^h	R ^h	India
	Randhunipagal	M	M	M	R ^h	R ^h	R ^h	R ^h	R ^h	R ^h	R ^h	R ^h	"
	Gabura Paddy	R ^h	MR	MR	R ^h	M	MR	MR	MR	MR	MR	MR	"
	Malio	M	M	R ^h	R	S	M	S	M	M	R ^h	R ^h	Indonesia
	Bandung Putih	M	S	R	M	MS	M	M	R	M	R	R	"
	Co. 25	R ^h	R	R	R ^h	MR	MR	MR	R ^h	MR	MR	R ^h	India
Exp. 2-23	Co. 26	R ^h	R	MR	R	MR	MR	MR	MR	MR	MR	MR	"
	T 608	R ^h	M	R	R	MR	R	R	R	R	M	M	"
	B24-92	MR	M	MR	M	M	M	M	M	M	M	M	Burma
	Leter	MS	MS	MR	M	M	M	M	M	M	M	M	Indonesia
	Nagedheu	MR	MS	M	MR	M	M	M	M	M	M	M	"

No. of experiment	Variety	Fungus Strain										Country of Origin		
		P-2b	53-33	AI 72	Kita 1	54-20	54-04	Ine 168						
Exp. 2-25	Chitrai	M	MS	R ^h	M	M	MR	MR	MR	MR	MR	MR	Pakistan	O
	820	MR	M	R ^h	MR+MS	MR+MS	R+MS	R+MS	R+MS	R+MS	R+MS	R+MS	Japan	O
	Nang Kieu	R	M	R	MR	M	M	M	M	M	M	M	Indonesia	O
	Ptb 16	R	MR	R ^h +M	R+M	R+MS	R ^h +M	R+MS	Ceylon	O				
	Mirasaki Daikoku	S	S	S	S	S	S	S	S	S	S	S	Japan	
	Suiho	S	S	R ^h	S	S	S	M	M	M	M	R	"	
Exp. 2-28	Dhepi	MR	MS	M	M	M	M	M	M	M	MS	MS	Pakistan	O
	Patnai	M	MS	M	M	M	M	M	M	M	MS	MS	"	O
	Brondjong	M	MS	R	M	MS	M	M	M	M	R	R	Indonesia	O
	T.K.M.I.	R ^h	R ^h	R	R ^h	R ^h	R ^h	R ^h	R ^h	R ^h	MR	MR	India	O
	Hatishail	MS	MS	M	M	M	M	M	M	M	MS	MS	Pakistan	O
	Dudsar	M	MS	M	M	M	M	M	M	M	M	MS	"	O
Exp. 2-34	Russia No. 25	R	MS	M	R	R	R	R	R	R	R	R	(Univ of Kyushu)	O
	Chiang-tao	M	MS	R	M	M	M	M	M	M	M	M	China	O
	Java No. 10	M	M	R	M	M	M	M	M	M	M	M	(Univ of Kyushu)	O
	Pai-ku-hua-lo	M	MS	R	MR	MR	MS	MS	MS	MS	MS	MS	Taiwan	O
	Russia No. 29	R	MS	M	R	R	R	R	R	R	MR	MR	(Univ of Kyushu)	O
	Modan	M	M	R	R ^h	R ^h	R ^h	R ^h	R ^h	R ^h	R ^h	R	India	O
Exp. 2-39	Lua Rong	M	MS	M	R	R	R ^h	North Viet Nam	O					
	Basilanon	MS	S	M	S	S	S	M	M	M	M	M	Philippines	O
	Kuan-yin-sen	MS	S	MR	MS	MS	MS	MS	MS	MS	R	R	China	O
	Russia No. 24	M	S	MS	R	R	R	R	R	R	R	R	(Univ of Kyushu)	O
	Pulut Mangka	R	R	M	R	R	R	M	M	M	M	M	Java	O
	Mas-M24	M	S	M	S	S	S	S	S	S	S	S	Ceylon	O

No. of experiment	Variety	Fungus Strain										Country of Origin
		P-2b	53-33	A1 72	Kita 1	54-20	54-04	Ine 168				
Exp. 2-47	Bengawan B-27	R	MR	R	R	R	MR	R	MR	R	MR	Ceylon
	Mavi-Bil	MR	MS	R	R	R	M	MR	M	MR	R	"
	Oddavalen	MR	M	R	R	R	R	R	R	R	M	"
	Shan-kan-ho	M	MS	R	R	M	MR	M	R	R	R	China
	Ketangadjih	M	M	M	M	M	MR	M	M	M	M	Indonesia
	Russia No. 61	MR	M	MS	R	R	R	R	R	M	M	(Univ of Kyushu)
Exp. 2-49	Tsao-tao-ku	R	M	R	R	M	M	MR	M	MR	MR	China
	Ko-tien-tao	Rh	R	R	R	R	MR	R	R	R	R	"
	Russia No. 80	M	S	MS	S	M	M	MR	M	M	M	(Univ of Kyushu)
	Russia No. 78	M	S	S	S	R	M	R	R	R	R	"
	Russia No. 83	R	R	Rh	S	R	MR	R	R	R	R	"
	Russia No. 31	MR	S	S	S	R	MR	R	R	R	M	"

Remarks: * means very little mixture of other individual plants with different disease resistance.
A + B means an approximately even mixture of disease resistant strains A and B.
O means seeds grown at Chinese Agr. Exp. Farm.
Δ means seeds grown at Fujisaka Exp. Station.
X means seeds grown at Aichi Prefectural Agr. Exp. Station.

All other samples, seeds were grown at Institute of Agricultural Sciences.

Table 3 shows a grouping of Japanese varieties of rice and some foreign rice varieties according to their degree of disease resistance. With respect to the 54-04 fungus strain, there is undoubtedly a genetic difference between the M varieties and the S varieties, but since the difference in disease resistance between the two types could be determined only with difficulty, differences in the degree of disease resistance in this case were disregarded. In the following classification, the disease resistant characteristics of parent and descendent varieties were also taken into consideration.

Table 3. Grouping of varieties according to disease resistance.

- | | |
|--|--|
| (a) S to all fungi: | Shinyamabuki, Sanin No. 45, Sachiwatari, Kanto No. 60, Tokai No. 11, Wase Aikoku No. 3, Ginbozu Chusei, Aichi Wase No. 1, Tasensho, Shinju, Wase Asahi No. 2, Togo, Kokuryo Miyako, Senichi, Murasaki Daikoku. |
| (b) R to A1-72 and Ine-168, but S to all other fungi: | Takara, Kaori, Tokai No. 9, Norin No. 27, Mikawa Nishiki, Chusei Honen, Takane Asahi, Shiro Sembon, Asakaze, Fujiminori, Suiho. |
| (c) M to P-2b, A1-72, 54-20, Ine-168, but S to all others: | Fu-strain No. 59. |
| (d) M to P-2b, very R to Kita No. 1, 54-20, Ine-168: | Fu-strain mochi rice No. 57. |
| (e) M to P-2b, very R to A1-72, Kita-1, 54-20, Ine-168: | North China T'ai-mi. |
| (f) R to A1-72, Ine-168, M to Kita-1, 54-20: | Shimokita, Pi No. 1, Pi No. 2. |