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Susceptibility of Tongil type Rice Cultivar Milyang 30 previously Resistant to *Xanthomonas campestris* pv. *oryzae*.

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"密陽 30號"의 흰빛잎마름病(白葉枯病)罹病化

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ABSTRACT

This study was conducted to investigate the incidence of bacterial leaf blight(BLB) in Milyang 30 which was previously considered to be resistant to *Xanthomonas campestris* pv. *oryzae*.

Seeds of Milyang 30 were collected from Suweon, Milyang and Haenam. When rice plants from different source were inoculated at the maximum tillering stage and flag leaf stage, reactions of Milyang 30 were consistant. The susceptibility of Milyang 30 was found to be due to infection with some isolates in the pathotype II of *X. campestris* pv. *oryzae*.

INTRODUCTION

Bacterial leaf blight of rice caused by *Xanthomonas campestris* pv. *oryzae* is one of the most important rice diseases in Korea. Since chemical control of bacterial leaf blight of rice is neither effective nor economically feasible, development of resistant rice cultivars has been emphasized in Korean rice breeding program.

Various pathotypes of *X. campestris* pv. *oryzae* were reported in Korea as well as in Japan[1,7,11]. Studies on the distribution of bacterial pathotypes and the resistance of leading cultivars and elite lines to each pathotype have been conducted since 1976 [1]. There were differences among rice cultivars in resistance to each of pathotypes.

The rice cultivar Milyang 30 was resistant to the isolates of pathotypes I and II has been widely cultivated in the middle and the southern regions endemic with the bacterial disease since its release in 1977. Then, Milyang 30 was severely diseased with bacterial leaf blight in some regions in 1979. And most of isolates from the diseased plants of Milyang 30 belonged to pathotype I and II when tested on rice differentials. The result suggested that there

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would be a wide range of variation in virulence of the isolates even in a pathotype. In 1958, Kuhara *et al.*[8] first reported that rice cultivar 'Asakaze' resistant to some pathotypes of *X. campestris* pv. *oryzae* became susceptible to a new virulent pathotype.

The present study was conducted to investigate on the susceptibility of Milyang 30 to bacterial leaf blight(BLB).

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MATERIALS AND METHODS

Seeds of Milyang 30 collected from farmers fields in Suweon, Milyang and Haenam and the breeder's lines were used for this study. The rice plants were transplanted individually to experimental plot after they were grown in nursery bed for 40 days. Application of fertilizers and other cultivation practices followed the ordinary standards.[10]

The 26 isolates of *X. campestris* pv. *oryzae* in pathotype I, II or III were used for the experiment. Each isolate was cultured on potato semisynthetic broth(potato, peeled and diced 300g, $Ca(NO_3)_2 \cdot 4H_2O$ 0.5g, $Na_2HPO_4 \cdot 12H_2O$ 2g, peptone 5g, dextrose 20g, distilled water to make up the volume to 1000m*l*) in shake for two or three days at 28°C, and was diluted with distilled water to a concentration of 10^8cells/m*l*, and used for the inoculation. Inoculation was made at the maximum tillering stage and flag leaf stage of Milyang 30. The upper-most and the flag leaves were inoculated with the bacterial suspension at the tops of the leaves by the clipping method. About ten leaves of an individual plant were inoculated.

Symptom development in plants were recorded 15 days after inoculation based on the extension of the lesion spread downward from the point of inoculation by the symptom index of 0 to 9(0 : No incidence, 1 : Trace around inoculation point, 3 : Less than 2cm lesion length, 5 : Above 50% in percentage of lesion length, 7 : Above 70% in percentage of lesion length, 9 : Above 90% in percentage of lesion length). The percentage of lesion length was calculated over the whole leaf length.

RESULTS

Isolates from the diseased leaves of Milyang 30 were tested for their virulence to rice differentials from 1979 to 1981. Isolates from Milyang 30 were classified into four pathotypes I, II, III and IV on the basis of their virulence to the rice differentials. Milyang 30 became susceptible to isolates in pathotypes I and II, (Table 1) but the remarkable differences in virulence were observed among the isolates.

The symptom severity of Milyang 30 infected with each of 15 isolates at the maximum tillering stage was shown in Table 2. Most of the inoculated plants were resistant to pathotype I, but only two plants were susceptible to the isolates 'CN 7937' in the same pathotype. Milyang 30 was resistant to two isolates, JN 7944 and KB 7947, in pathotype II, but reactions to other three isolates was either resistant or susceptible. The symptom severity of Milyang 30 to two isolates, JN 7998 and JN 79118, in pathotype III was variable showing different degrees from 0 to 9. However, Milyang 30 infected with each of other four soilates in pathotype III produced severe symptom as usual(Table 2).

To investigate the symptom severity at the heading time of Milyang 30 to bacterial leaf blight, the 17 isolates belonging to bacterial pathotype I, II and III were inoculated at the flag leaf stage. As shown in Table 3, the experimental results were similar to those obtained at the maximum tillering stage. The symptom severities of Milyang 30 to five isolates in pathotype I showed resistant reaction, but only two plants out of 1269 plants inoculated with isolate 'KB 7933' became susceptible.

Milyang 30 was resistant to two isolates, JN 7944

Table 1. Number of isolates isolated from Milyang 30 from 1979 to 1981 classified into each pathotype.

Year	Number of isolates in each pathotype				
	I	II	III	IV	V
1979	1	8	6	0	0
1980	8	11	5	0	0
1981	5	5	4	1	0

Table 2. Symptom severity of rice cultivar Milyang 30 inoculated with each of 15 isolates of *X. campestris* pv. *oryzae* at the maximum tillering stage.

Pathotype	Isolate	No. of plants tested	No. of plants in each symptom severity index					
			0	1	3	5	7	9
I	G 7911	360	360	0	0	0	0	0
	KB 7933	360	360	0	0	0	0	0
	CN 7937	360	358	0	0	1	1	0
	JB 7989	360	360	0	0	0	0	0
II	JB 7779	345	0	0	29	90	144	82
	KB 7813	339	0	124	171	44	2	0
	JN 7853	331	128	69	49	47	38	1
	JN 7944	345	345	0	0	0	0	0
	KB 7947	348	348	0	0	0	0	0
III	JN 7998	346	142	61	15	35	84	9
	JN 79103	357	0	0	0	2	64	291
	JN 79118	352	162	36	25	41	65	23
	JN 79127	352	0	0	0	11	63	278
	JN 79129	353	0	0	1	2	28	322
	JN 79132	356	0	0	0	8	50	298

Table 3. Symptom severity of farmer's seed of Milyang 30 inoculated with each of 17 isolates of *X. campestris* pv. *oryzae* at the flag leaf stage.

Pathotype	Isolate	No. of plants tested	No. of plants in each symptom severity index					
			0	1	3	5	7	9
I	CB 7801	1347	1347	0	0	0	0	0
	G 7911	1349	1349	0	0	0	0	0
	KB 7933	1269	1267	0	0	0	0	2
	CN 7937	1343	1343	0	0	0	0	0
	JB 7989	1013	1013	0	0	0	0	0
II	JB 7779	1199	34	304	522	252	87	0
	CN 7808	1709	1705	0	1	1	1	1
	KB 7813	1383	5	211	495	397	251	24
	JN 7853	1309	362	560	303	80	4	1
	JN 7944	1336	1336	0	0	0	0	0
	KB 7947	1295	1294	0	0	0	0	1
III	JN 7998	1581	279	476	82	41	328	375
	JN 79103	1133	0	2	2	10	120	999
	JN 79118	1365	217	533	45	77	277	216
	JN 79127	1109	2	0	0	5	109	993
	JN 79129	1018	4	328	492	192	2	0
	JN 79132	1125	0	342	476	287	20	0

Table 4. Symptom severity of breeder's seed of the Milyang 30 inoculated with each of 19 isolates of *X. campestris* pv. *oryzae* at the flag stage.

Pathotype	Isolate	No. of plants tested	No. of plants in each symptom severity index					
			0	1	3	5	7	9
I	KB 7933	137	125	0	0	4	3	5
	JB 7989	138	131	0	7	0	0	0
II	CN 7808	144	135	3	3	3	0	0
	KB 7813	125	5	15	52	40	13	0
	JB 7838	136	125	4	3	3	1	0
	JN 7853	119	17	46	51	4	1	0
	KB 7866	143	136	0	0	0	7	0
	KB 7867	137	11	24	18	21	63	0
	KB 7880	146	136	0	0	0	10	0
	CN 7888	148	138	0	0	0	10	0
	JB 7899	138	134	0	0	0	0	4
	JB 78106	145	140	1	4	0	0	0
	JN 7944	146	146	0	0	0	0	0
	KB 7947	154	147	3	4	0	0	0
	JN 79126	130	0	21	82	26	1	0
III	JN 7998	130	3	17	10	2	73	25
	JN 79118	143	10	9	14	29	80	1
	JN 79124	126	0	0	0	2	45	79
	JN 79127	130	0	0	0	15	99	16

and KB 7947 in pathotype II but reactions to four other isolates in the same pathotype was variable. The symptom severity in Milyang 30 infected with each isolate in pathotype III was variable(Table 3).

Milyang 30 from the breeder's seed produced resistant symptoms when inoculated with the isolate 'JB 7989' in pathotype I. But reactions were either resistant or susceptible when inoculated with the isolate 'KB 7933' in the same pathotype. Thus reaction of breeder's line to pathotype I was similar to that of Milyang 30,collected from farmer's field. (Table 3 and 4).

Reactions of Milyang 30 from the breeder's line to pathotype II were variable depending upon isolates used. The breeder's line of Milyang 30 was susceptible to two isolates, JN 79124 and JN 79127 in pathotype III. But reactions to two other isolates, JN 7998 and JN 79118, was either resistant or susceptible.

DISCUSSION

The rice cultivar 'Asakaze' was unexpectedly diseased with BLB in Fukuoka prefecture of Japan in 1958[8]. This appears to be the first report that a previously resistant rice cultivar became susceptible to newly derived virulent isolates of BLB[8]. The bacterial leaf blight isolates were classified into 5 pathotypes by Kozaka[7], Yamamoto *et al.*[13] and Horino *et al.*[5].

The Tongil type rice cultivar Milyang 30 with multiple resistance to diseases and insects developed in 1977 was released and widely cultivated in southern part of Korea. However, the resistance of Milyang 30 to bacterial leaf blight was broken down in some farmers' fields in 1979. It was suggested that resistance of Milyang 30 was mainly due to incompatible combinations in pathotype I and II[2,4].

The symptom severity of Milyang 30 to the isola-

tes in pathotype II indicated there were variability in virulence among isolates in pathotype II. It appeared that infection of Milyang 30 by some isolates in pathotype II was due to the variation in aggressiveness of the isolates.

In comparison with virulence of isolates within a pathotype distributed in Japan and the Philippines, isolates in pathotype I from Japan did not infect IR 20, whereas the Philippinese isolates in the same pathotype caused small lesion on IR 20[3]. On the other hand, most of the pathotype I isolates found in Korea caused susceptible reaction on IR 20[3], indicating that the virulence of Korean isolates was different from those of Philippinese and Japanese isolates. Yamamoto[12] also reported that the highly virulent strains were isolated from the area cultivated with resistant rice cultivars. Thus, the variable reaction of Milyang 30 to pathotype II isolates appears to be due to the variation of isolates in virulence. Since Korean rice cultivars related to Milyang 30 have been cultivated for a long time, a new compatible isolates in pathotype I & II might have been selected.

It has been reported by previous workers that the resistance of rice cultivar to *X. campestris* pv. *oryzae* was governed by one or two major genes[9,11]. However, our results suggested that the resistance of Indica x Japonica rice cultivar such as Milyang 30 might be governed by more than one and minor genes.

摘　要

白葉枯病에 對한 抵抗性品種으로 알려진 密陽 30號의 罹病化原因을 究明하기 위하여 水原, 密陽, 海南産에 對한 最高分蘖期, 出穗止葉과 基本植物에 對한 各 菌群의 菌株別 抵抗性 關係를 調査한 結果

가. 1979～'81年 全國에서 罹病된 密陽 30號의 侵害菌株는 非親和性으로 밝혀진 Ⅰ, Ⅱ 菌群의 菌株가 多數 分離되었다.

나. 産地 및 生育時期別 抵抗性 程度의 差는 認定할 수 없었으나 Ⅱ 菌群의 特殊菌株(病原性 分化型)에 對해 侵害받았음이 原因이었다.

다. 密陽 30號의 基本植物에서도 同一 菌群 菌株에 依해 反應이 一致되므로 品種보다 菌株의 病原性 分化에 따른 罹病化임을 알 수 있었다.

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