

Xanthomonas campestris pv. oryzaeの血清学的特異性

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Serological Specificity of *Xanthomonas campestris* pv. *oryzae*

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崔 在乙*・松山宣明*・脇本 哲* : *Xanthomonas campestris*
pv. *oryzae* の血清学的特異性

Abstract

By means of agglutination test with antisera produced against three different serovars of *Xanthomonas campestris* pv. *oryzae*, positive reaction was observed not only with the antigens belonging to homologous pathovars but also with those of other pathovars such as *X. campestris* pv. *citri*, *X. campestris* pv. *hordei*, *X. campestris* pv. *vesicatoria* and *X. campestris* pv. *vitians*, suggesting that they have common antigens. In gel diffusion test, however, the antisera showed specific reactions. Among antisera produced against three serovars of *X. campestris* pv. *oryzae*, the antiserum against Q7472 (serovar A) produced bands only with intact cells of the isolates belonging to homologous serovar, but antisera of Q7502 (serovar B-I) and N5837 (serovar B-II) produced bands with all species of xanthomonads and some of the other genera as well. The antiserum produced against sonicated cells of the isolate Q7472 produced bands with intact cells of all xanthomonads, but not with any species belonging to *Pseudomonas*, *Bacillus*, *Rhizobium* and *Corynebacterium* used in this experiment. The antiserum produced against sonicated cells of *X. campestris* pv. *oryzae* Q7472 showed positive reaction specifically with *X. campestris* pv. *oryzae* isolates, when antigens were previously treated by heating. Serovars B-I and B-II of *X. campestris* pv. *oryzae* showed severe autoagglutination in CaCl₂ solution, but serovar A did not, suggesting possible differentiation of these serovars from each other or from other xanthomonads by this method.

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Introduction

Serological tests have been utilized for determining the inter- or intra-specific relationship among phytopathogenic bacteria. By means of gel diffusion test, Vrugink and Maasgeesteranus¹⁹⁾ differentiated *Erwinia carotovora* subsp. *atroseptica* from *E. carotovora* subsp. *carotovora*, and Lovrekovich *et al.*^{9,10)} and others^{11,16)} made clear that the heat-stable antigens of *Pseudomonas syringae* pv. *syringae* and *P. syringae* pv. *morsprunorum* were different from those of several other phytopathogenic pseudomonads. Brooks *et al.*¹⁾ reported close immunological relationships between *X. campestris* pv. *campestris* and other pathovars such as *X. campestris* pv. *malvacearum*, *X. campestris* pv. *phaseoli*, *X. campestris* pv. *pelargonii* and *X. campestris* pv. *vitians*, while Elord and Braun^{4,5,6)} divided 36 species of *Xanthomonas* into five serological groups based on cross agglutination. Yano *et al.*²⁰⁾ reported that 14 nomenclatures of *X. campestris* group were classified into nine serovars by indirect hemagglutination test. According to the report of Shekhawat and Chakravarti¹⁷⁾,

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gel diffusion test could be used to differentiate *X. campestris* pv. *vesicatoria* from other pathovars of *X. campestris* and other phytopathogenic bacteria belonging to *Pseudomonas*, *Erwinia*, *Corynebacterium* and *Agrobacterium* as well.

Mahanta and Addy¹²⁾ and Obata and Tsuboi¹⁵⁾ attempted to elucidate the serological relationship between *X. campestris* pv. *oryzae* and other phytopathogenic bacteria. The former reported that most of phytopathogenic bacteria belonging to xanthomonads, pseudomonads and erwiniae share some of the common antigens with *X. campestris* pv. *oryzae*, but the latter concluded that any phytopathogenic bacteria did not react with *X. campestris* pv. *oryzae* antiserum by gel diffusion test. Fang *et al.*⁷⁾ differentiated *X. campestris* pv. *oryzae* from other xanthomonads including *X. campestris* pv. *oryzicola* by agglutination test. Choi *et al.*²⁾ found out serological variations among isolates of *X. campestris* pv. *oryzae* and separated them into three serovars, A, B-I and B-II, by gel diffusion test.

In this investigation, agglutination test, gel diffusion test and autoagglutination test were carried out to make clear the serological relationship between three serovars of *X. campestris* pv. *oryzae* and other phytopathogenic bacteria.

Materials and Methods

Isolates. The isolates of various phytopathogenic bacteria which have been preserved by freeze-drying at our laboratory were used in this study. The freeze-dried bacteria were transferred to PSA slant medium (potato decoction 1 liter, $\text{Ca}(\text{NO}_3)_2$ 0.5 g, $\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$ 2 g, peptone 5 g, sucrose 15 g, agar 15 g, pH 7.0), incubated at 25 C for several days, and were transferred to the same medium at 2 to 3 days before use.

Serological techniques. Antisera were elicited in rabbits by intravenous administration of saline suspensions of antigens. Washed cell suspensions of *X. campestris* pv. *oryzae* isolates Q7472 (serovar A), Q7502 (serovar B-I) and N5837 (serovar B-II) and sonicated cell of Q7472 were used as antigens. The methods for preparing antisera, serological test and autoagglutination test applied in this experiment were reported previously.²⁾ Description of antisera prepared and used in this experiment are shown in Table 1.

Table 1. Description of antisera used in the present study

Antiserum prepared	<i>X. campestris</i> pv. <i>oryzae</i> isolate used for preparing antiserum	Serovar of the isolate	Pathogenic group of the isolate	Treatment given prior to injection
Anti-Q7472-serum	Q7472	A	I	Intact whole cell (washed by centrifugation)
Anti-Q7502-serum	Q7502	B-I	IV	Do
Anti-N5837-serum	N5837	B-II	— ^{a)}	Do
Anti-Q7472 (sonic.)-serum	Q7472	A	I	Sonicated for 20 min

a) Not known.

Table 2. Agglutination reaction of phytopathogenic bacteria against *X. campestris* pv. *oryzae* antisera

Phytopathogenic bacteria	Anti-Q7472 -serum	Anti-Q7472 (sonic.) -serum	Anti-Q7502 -serum	Anti-N5837 -serum	Anti-H5809 -serum ^{a)}	Anti-H120 -serum ^{b)}
<i>X. campestris</i> pv. <i>oryzae</i>	640*	2560*	2560*	5120*	5120*	5120*
<i>X. campestris</i> pv. <i>campestris</i> (NIAS)	0	0	0	0	40	640
<i>X. campestris</i> pv. <i>cucurbitae</i> (NIAS)	0	0	0	0	0	—
<i>X. campestris</i> pv. <i>hyacinthi</i> (NIAS)	0	0	0	0	0	160
<i>X. campestris</i> pv. <i>glycines</i> (NIAS)	0	0	0	0	0	320 ^{c)}
<i>X. campestris</i> pv. <i>physalidicola</i> (NIAS)	0	0	0	0	—	—
<i>X. campestris</i> pv. <i>citri</i> (1-1)	10	20	10	10	0	320
<i>X. campestris</i> pv. <i>pisi</i> (1)	0	0	0	0	—	—
<i>X. campestris</i> pv. <i>pruni</i> (X1-10-1)	0	0	0	0	0	640
<i>X. campestris</i> pv. <i>hordei</i> (X1-11-1)	10	10	10	40	80	1280 ^{d)}
<i>X. campestris</i> pv. <i>vesicatoria</i> (NIAS)	160	20	80	80	—	640
<i>X. campestris</i> pv. <i>vitians</i> (NIAS)	80	20	80	80	—	—
<i>A. tumefaciens</i> (S-2)	0	0	0	0	—	0
<i>B. cereus</i> (IAM 1027)	0	0	0	0	—	—
<i>B. polymyxa</i> (AMS6501)	0	0	0	0	—	—
<i>C. michiganense</i> pv. <i>sepedonicum</i> (17-4)	0	0	0	0	0	0
<i>E. carotovora</i> subsp. <i>carotovora</i> (N7129)	0	0	0	0	0	—
<i>P. solanacearum</i> (C-319)	0	0	0	0	0	160
<i>P. syringae</i> pv. <i>syringae</i> (P-38)	0	0	0	0	—	320
<i>R. phaseoli</i> (406)	0	0	0	0	—	—

a) Obata, T. and Tsuboi, F.

b) Mahanta, C. and Addy, S.

c) *X. campestris* pv. *phaseoli*.d) *X. campestris* pv. *celealis*.

*: Titer in homologous antigen-antiserum reaction.

—: Not tested.

Results

Agglutination test

The results of agglutination test carried out with four kinds of *X. campestris* pv. *oryzae* antisera are given in Table 2. All antisera showed high titers with homologous antigens. Positive reactions were also observed with heterologous antigens such as *X. campestris* pv. *citri*, *X. campestris* pv. *hordei*, *X. campestris* pv. *vesicatoria* and *X. campestris* pv. *vitians*, however, the titers were very low. *X. campestris* pv. *campestris*, *X. campestris* pv. *cucurbitae*, *X. campestris* pv. *hyacinthi*, *X. campestris* pv. *pisi*, *X. campestris* pv. *glycines*, *X. campestris* pv. *physalidicola*, *X. campestris* pv. *pruni*, *Agrobacterium tumefaciens*, *Bacillus cereus*, *B. polymyxa*, *Corynebacterium michiganense* pv. *sepedonicum*, *Erwinia carotovora* subsp. *carotovora*, *Pseudomonas solanacearum*, *P. syringae* pv. *syringae* and *Rhizobium phaseoli* did not agglutinate with any of the antisera.

Gel diffusion test

The four antisera were tested against phytopathogenic bacteria in gel diffusion test.

Table 3. Number of precipitin bands produced by interactions of *X. campestris* pv. *oryzae* antisera and unheated whole cell antigens of phytopathogenic bacteria in gel diffusion test

Phytopathogenic bacteria	Anti-Q7472 -serum	Anti-Q7472 (sonic.) -serum	Anti-Q7502 -serum	Anti-N5837 -serum	Anti-H5809 -serum ^{a)}	Anti-H120 -serum ^{b)}
<i>X. campestris</i> pv. <i>oryzae</i> (serovar A)	1*	3-5*	2-3	1-3	1*	6*
<i>X. campestris</i> pv. <i>oryzae</i> (serovar B-I)	0	2-3	2-4*	1-3	—	—
<i>X. campestris</i> pv. <i>oryzae</i> (serovar B-II)	0	2-3	2-3	2-3*	—	—
<i>X. campestris</i> pv. <i>campestris</i> (4) ^{c)}	0	2-3	2	2	0	5
<i>X. campestris</i> pv. <i>cucurbitae</i> (2)	0	2-3	2-3	1-2	0	—
<i>X. campestris</i> pv. <i>hyacinthi</i> (1)	0	3	2-3	1-2	0	3
<i>X. campestris</i> pv. <i>glycines</i> (1)	0	3	2-3	1-2	0	2 ^{d)}
<i>X. campestris</i> pv. <i>physalidicola</i> (1)	0	3	2	1-2	—	—
<i>X. campestris</i> pv. <i>citri</i> (4)	0	2-3	2	2-3	0	3
<i>X. campestris</i> pv. <i>pisi</i> (3)	0	2-3	1-2	2-3	—	—
<i>X. campestris</i> pv. <i>pruni</i> (1)	0	2	1-2	1	0	4
<i>X. campestris</i> pv. <i>hordei</i> (2)	0	1-2	1-2	1	0	3 ^{e)}
<i>X. campestris</i> pv. <i>vesicatoria</i> (1)	0	2	1-2	2	—	3
<i>X. campestris</i> pv. <i>vitians</i> (2)	0	2	1-2	2	—	—
<i>A. tumefaciens</i> (3)	0	0	0	0	—	0
<i>B. cereus</i> (2)	0	0	0	0	—	—
<i>B. polymyxa</i> (2)	0	0	0	0	—	—
<i>C. michiganense</i> pv. <i>sepedonicum</i> (3)	0	0	0	0	0	0
<i>E. carotovora</i> subsp. <i>carotovora</i> (3)	0	0	1-2	1	0	—
<i>P. solanacearum</i> (3)	0	0	1	1	0	4
<i>P. syringae</i> pv. <i>syringae</i> (3)	0	0	1-2	1	—	3
<i>R. phaseoli</i> (1)	0	0	0	0	—	—

a) Obata, T. and Tsuboi, F.

b) Mahanta, C. and Addy, S.

c) Number of the isolates tested.

d) *X. campestris* pv. *phaseoli*.

e) *X. campestris* pv. *cerealis*.

*: Homologous antigen-antiserum reaction.

—: Not tested.

The numbers of precipitin bands varied depending upon combinations of antisera and antigens (Table 3). Anti-Q7472-serum produced single band only with the isolates belonging to the homologous serovars A of *X. campestris* pv. *oryzae*, while anti-Q7502-serum showed one to three bands against intact cells of phytopathogenic bacteria such as *X. campestris* pv. *campestris*, *X. campestris* pv. *cucurbitae*, *X. campestris* pv. *hyacinthi*, *X. campestris* pv. *glycines*, *X. campestris* pv. *physalidicola*, *X. campestris* pv. *citri*, *X. campestris* pv. *pruni*, *X. campestris* pv. *hordei*, *X. campestris* pv. *vitians*, *Pseudomonas solanacearum*, *P. syringae* pv. *syringae* and *Erwinia carotovora* subsp. *carotovora*. Some of the bands produced in these combinations were identical. Similar results were also obtained with anti-N5837-serum. Sonication of bacterial cells changed their serological specificity. The anti-Q7472 (sonic.)-serum produced one to three bands with intact cells of all xanthomonads and at least one of them was produced by common antigens. Any species belonging to *Pseudo-*

Table 4. Number of precipitin bands produced by interactions of *X. campestris* pv. *oryzae* antisera and heated^{a)} antigens of phytopathogenic bacteria in gel diffusion test

Phytopathogenic bacteria	Anti-Q7472 -serum	Anti-Q7472 (sonic.) -serum	Anti-Q7502 -serum	Anti-N5837 -serum	Anti-H5809 -serum ^{b)}	Anti-H120 -serum ^{c)}
<i>X. campestris</i> pv. <i>oryzae</i> (serovar A)	2*	2-4*	2-3	2-3	1*	2*
<i>X. campestris</i> pv. <i>oryzae</i> (serovar B-I)	0	1-2	1-2*	1-2	—	—
<i>X. campestris</i> pv. <i>oryzae</i> (serovar B-II)	0	1-2	0	1-2*	—	—
<i>X. campestris</i> pv. <i>campestris</i> (4) ^{d)}	0	0	0	0	0	0
<i>X. campestris</i> pv. <i>cucurbitae</i> (2)	0	0	1	1	0	—
<i>X. campestris</i> pv. <i>hyacinthi</i> (1)	0	0	1	1	0	0
<i>X. campestris</i> pv. <i>glycines</i> (1)	0	0	1	1	0	0 ^{e)}
<i>X. campestris</i> pv. <i>physalidicola</i> (1)	0	0	1	1	—	—
<i>X. campestris</i> pv. <i>citri</i> (4)	0	0	1	1	0	0
<i>X. campestris</i> pv. <i>pisi</i> (3)	0	0	1	1	—	—
<i>X. campestris</i> pv. <i>pruni</i> (1)	0	0	1	1	0	0
<i>X. campestris</i> pv. <i>hordei</i> (2)	0	0	1	0	0	0 ^{f)}
<i>X. campestris</i> pv. <i>vesicatoria</i> (1)	0	0	1	0	—	0
<i>X. campestris</i> pv. <i>vitians</i> (2)	0	0	1	0	—	—
<i>A. tumefaciens</i> (3)	0	0	0	0	—	0
<i>B. cereus</i> (2)	0	0	0	0	—	—
<i>B. polymyxa</i> (3)	0	0	0	0	—	—
<i>C. michiganense</i> pv. <i>sepedonicum</i> (3)	0	0	0	0	0	0
<i>E. carotovora</i> subsp. <i>carotovora</i> (3)	0	0	0	0	0	—
<i>P. solanacearum</i> (3)	0	0	0	0	0	0
<i>P. syringae</i> pv. <i>syringae</i> (3)	0	0	0	0	—	0
<i>R. phaseoli</i> (1)	0	0	0	0	—	—

a) Heated at 100 C for 1 hr.

b) Obata, T. and Tsuboi, F.

c) Mahanta, C. and Addy, S.

d) Number of the isolates tested.

e) *X. campestris* pv. *phaseoli*.

f) *X. campestris* pv. *cerealis*.

*: Homologous antigen-antiserum reaction.

—: Not tested.

monas, *Bacillus*, *Corynebacterium* and *Erwinia* did not produce precipitin bands with *X. campestris* pv. *oryzae* antisera. *X. campestris* pv. *oryzae* antigen formed at least one specific band close to the antigenic well (Fig. 1). The common bands tended to make the specific band obscure, but in most cases the specific band was easily detectable. Since the antigen specific for *X. campestris* pv. *oryzae* was tolerant to heat, heating of bacterial cells at 100 C for 1 hr sufficiently eliminated the common antigen with negligible effect on the specific antigens. When heated antigens were used, anti-Q7472(sonic.)-serum produced 2 to 4 bands with serovar A of *X. campestris* pv. *oryzae* while 1 to 2 bands with B-I and B-II, both of which were specific for *X. campestris* pv. *oryzae* as shown in Table 4.

Autoagglutination

The isolates of *X. campestris* pv. *oryzae* belonging to serovar B-I and B-II showed

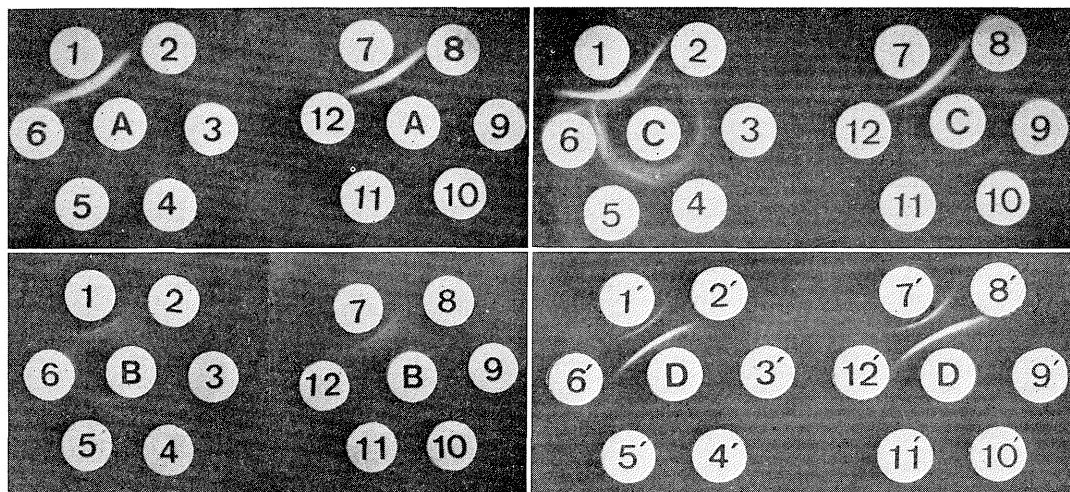


Fig. 1. Serological reactions between *X. campestris* pv. *oryzae* antisera and phytopathogenic bacteria.

Center wells A, B, C and D contain anti-Q7472-serum, anti-Q7502-serum, anti-Q7472(sonic.)-serum and anti-Q7472(sonic.)-serum, respectively. Outer wells were filled with intact cell suspension of 1 and 7; *X. campestris* pv. *oryzae*, 2; *X. campestris* pv. *campestris*, 3; *X. campestris* pv. *cucurbitae*, 4; *X. campestris* pv. *hyacinthi*, 5; *X. campestris* pv. *glycines*, 6; *X. campestris* pv. *physalidicola*, 8; *X. campestris* pv. *citri*, 9; *X. campestris* pv. *pruni*, 10; *X. campestris* pv. *hordei*, 11; *X. campestris* pv. *vesicatoria* and 12; *X. campestris* pv. *vitians*. The wells 1'-12' contain the cell suspensions of respective numbers heated at 100 C for 1 hr.

Table 5. Autoagglutination of phytopathogenic bacteria in NaCl and CaCl₂ solutions

Phytopathogenic bacteria	0.85% NaCl	0.85% NaCl (H)	1% CaCl ₂	10% CaCl ₂
<i>X. campestris</i> pv. <i>oryzae</i> (serovar A)	—	+	+	+
<i>X. campestris</i> pv. <i>oryzae</i> (serovar B-I)	—	+++	+++	+++
<i>X. campestris</i> pv. <i>oryzae</i> (serovar B-II)	—	+++	+++	+++
<i>X. campestris</i> pv. <i>cucurbitae</i> (NIAS)	—	+	+	+
<i>X. campestris</i> pv. <i>hyacinthi</i> (NIAS)	—	+	+	+
<i>X. campestris</i> pv. <i>glycines</i> (NIAS)	—	+	+	+
<i>X. campestris</i> pv. <i>physalidicola</i> (2)	—	+	+	+
<i>X. campestris</i> pv. <i>citri</i> (1-1)	—	+	+	+
<i>X. campestris</i> pv. <i>pruni</i> (XI-10-1)	—	+	+	+
<i>X. campestris</i> pv. <i>hordei</i> (XI-11-1)	—	+	+	+
<i>X. campestris</i> pv. <i>vesicatoria</i> (NIAS)	—	+	+	+
<i>X. campestris</i> pv. <i>vitians</i> (NIAS)	—	+	+	+
<i>X. campestris</i> pv. <i>pisi</i> (1)	—	+	+	+
<i>C. carotovora</i> subsp. <i>carotovora</i> (N7129)	—	+++	+++	+++

H : Heat treatment at 100 C for 1 hr.

+++ : Complete autoagglutination.

++ : Partial autoagglutination.

— : No agglutination.

marked autoagglutination when they were suspended in 1 % or 10 % solution of CaCl_2 . As shown in Table 5, autoagglutination did not occur in 0.85 % NaCl solution at room temperature. When these suspensions were heated at 100 C for 1 hr, however, vigorous autoagglutination occurred only with the isolates belonging to serovar B-I and B-II and *E. carotovora* subsp. *carotovora*. Serovar A of *X. campestris* pv. *oryzae* and other xanthomonads also showed positive response with less intensity.

Discussion

In agglutination test the antisera of *X. campestris* pv. *oryzae* showed positive reaction not only with homologous pathovars but also with some heterologous pathovars such as *X. campestris* pv. *citri*, *X. campestris* pv. *vitians*, *X. campestris* pv. *hordei* and *X. campestris* pv. *vesicatoria*, suggesting the presence of some common antigens in these bacteria. Seven other pathovars belonging to *X. campestris*, two species of *Pseudomonas*, *E. carotovora* subsp. *carotovora*, two species of *Bacillus*, *Corynebacterium michiganense* pv. *sepedonicum*, *Rhizobium phaseoli* and *Agrobacterium tumefaciens* used in this experiment did not show any response to *X. campestris* pv. *oryzae* antisera in agglutination test. Obata and Tsuboi¹⁵⁾ reported that *X. campestris* pv. *oryzae* antiserum did not react with other phytopathogenic bacteria in agglutination test with only exception of *X. campestris* pv. *hordei* and *X. campestris* pv. *campestris*. According to the report by Mahanta and Addy¹²⁾, however, *X. campestris* pv. *oryzae* antiserum showed positive reaction with high titers against most of the species belonging to *Xanthomonas*, *Pseudomonas* and *Erwinia*, indicating that they have common antigens. The possible reason for the discrepancy between the results obtained by Obata and Tsuboi and the one by the authors seems to exist in the difference of the isolates used for preparing antiserum.

In gel diffusion test, anti-Q7502-serum and anti-N5837-serum showed 1 to 4 bands against the antigens of all xanthomonads, *P. solanacearum*, *P. syringae* pv. *syringae* and *E. carotovora* subsp. *carotovora*, while anti-Q7472-serum did not react with any phytopathogenic bacteria other than *X. campestris* pv. *oryzae* isolates belonging to serovar A. Anti-H5809-serum was reported to be completely specific to *X. campestris* pv. *oryzae* in gel diffusion test,¹⁵⁾ while anti-H120-serum was not specific for *X. campestris* pv. *oryzae* and produced bands against all pathovars of *X. campestris*, two species of *Pseudomonas* and *Erwinia* spp.¹²⁾ These results suggest that the isolates belonging to serovar A,²⁾ such as Q7472 and H5809 have serovar-specific antigens, but the isolates Q7502, N5837 and H120 have several antigens which are common to both *X. campestris* pv. *oryzae* and some other phytopathogenic bacteria.

Antiserum produced by injecting sonicated cells of the isolate Q7472 reacted with all xanthomonads, suggesting that some antigens were liberated from the cell by sonication to produce agglutinin. Muzoz¹⁴⁾ and others^{8,13,18)} reported that many antigenic substances were easily extractable from cell wall by trichloroacetic acid, HCl or NaOH solution or phenol-water.

When heat-treated antigens of phytopathogenic bacteria were used for gel diffusion test, anti-Q7472(sonic)-serum produced bands specific for *X. campestris* pv. *oryzae* (Fig. 1-D), while anti-Q7502-serum and anti-N5837-serum produced band with almost all of the xanthomonads. Thus the heat-stable antigen of *X. campestris* pv. *oryzae* was apparently

pathovar-specific against anti-Q7472(sonic.)-serum so far as this experiment was concerned. Although unheated antigens are useful for distinguishing *X. campestris* pv. *oryzae* from other bacteria, the heat-treated antigens were considered to be more valuable as their reactions in gel diffusion test were highly specific. Mahanta and Addy¹²⁾ also reported similar results with *X. campestris* pv. *oryzae* isolates from India. Lovrekovich *et al.*^{9,10)}, Lucas and Grogan¹¹⁾ and Otta and English¹⁶⁾ also demonstrated heat-stable specific antigens for *Pseudomonas*.

In gel diffusion test, all of the xanthomonads showed positive reaction with anti-Q7472 (sonic.)-serum, anti-Q7502-serum and anti-N5837-serum, producing 1 to 3 bands in each antigen-antibody reaction. In agglutination test, however, positive reaction was observed only with a few species of xanthomonads. These results suggest that antigens effective for agglutination and those for producing bands in gel diffusion test are different from each other; the former is considered to be insoluble somatic antigens and the latter soluble somatic antigens. De Boer *et al.*³⁾ reported that the agglutination titer did not always reflect the intensity of the precipitin band produced by immunodiffusion test.

Among *X. campestris* group bacteria, autoagglutination was observed only in serovars B-I and B-II of *X. campestris* pv. *oryzae* suggesting some specific factors closely related to this phenomenon.

These results indicated that serological test and autoagglutination test may be useful for identification of *X. campestris* pv. *oryzae*.

Serological relationships among serovars B-I and B-II of *X. campestris* pv. *oryzae* and other xanthomonads suggest some interesting problems from the evolutionary point of view.

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和 文 摘 要

Xanthomonas campestris pv. *oryzae* の血清学的特異性

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Xanthomonas campestris pv. *oryzae* は寒天ゲル内拡散法によって3種類の血清型 (A, B-I, B-II) に大別される。*X. campestris* pv. *oryzae* Q7472 菌株 (血清型 A) の抗血清は反応が特異的で、血清型 A に属する *X. campestris* pv. *oryzae* 菌株のみと反応した。同菌株の超音波処理菌体を抗原として作成した抗血清は、供試したすべての *Xanthomonas* 属細菌と反応し、1～5本の沈降帯を形成したが、熱処理 (100°C, 1時間) した抗原との反応は完全に病原型特異的であり、*X. campestris* pv. *oryzae* 以外の植物病原細菌とは全く反応しなかった。菌株 Q7502 (血清型 B-I) と N5837 (血清型 B-II) の抗血清は供試したすべての *Xanthomonas* 属細菌と1～4本の沈降帯を形成したが、また *Pseudomonas* 属および *Erwinia* 属細菌とも反応した。

塩化カルシウム溶液中における自己凝集反応は、供試した *Xanthomonas* 属細菌のうち、血清型 B-I および B-II に属する *X. campestris* pv. *oryzae* 菌株においてのみ顕著であった。

X. campestris pv. *oryzae* 菌株 Q7427 (血清型 A) の超音波処理菌を用いて作成した抗血清と加熱抗原との間の反応特異性は *X. campestris* pv. *oryzae* の同定に利用できるものと期待される。