**PATHOTYPE GROUPING OF *Xanthomonas oryzae* pv. *oryzae*,**

**ISOLATES FROM SOUTH SULAWESI AND SOUTHEAST SULAWESI**

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**ABSTRACT**

Bacterial leaf blight caused by *Xanthomonas oryzae* pv. *Oryzae* (Xoo) is an important rice disease, and has caused significant economic losses. Disease control using resistant varieties is often uneffective due to a high pathotype variability of the pathogen. This research aimed to determine the pathotype grouping and the distribution of Xoo isolates of South and Southeast Sulawesi. In order to obtain the information, 61 Xoo isolates of South Sulawesi and 29 isolates of Southeast Sulawesi were evaluated for their pathotype grouping against 5 diffential varieties. Research results showed that in South Sulawesi there were 2 pathotype groups, namely pathotype IV (32.79%) and pathotype VIII (67.21%). Pathotype VIII was widely distributed over the Western and Central areas of South Sulawesi, whereas pathotype IV was widely distributed over the Southern area. In Southeast Sulawesi, it was found 5 pathotypes, namely pathotypes IV (27.58%), VI (10.34%), VIII (13.79%), IX (20.68%), and X (27.58%), with a limited and scattered distribution pattern on several areas. These results indicate that Xoo pathotype groups in South Sulawesi and Southeast Sulawesi are varied and tend to sift to more virulent pathotypes.

Keywords: bacterial leaf blight, pathotype group, *Xanthomonas oryzae* pv. *oryzae*

ABSTRAK

Penyakit hawar daun bakteri (*Xanthomonas oryzae* pv. *oryzae*) merupakan penyakit penting pada padi dan menimbulkan kerugian secara ekonomis. Pengendalian dengan varietas tahan seringkali kurang efektif karena patogen ini memiliki keragaman patotipe yang tinggi. Penelitian ini bertujuan untuk mengetahui kelompok patotipe dan penyebaran  *Xanthomonas oryzae* pv. *oryzae* isolat asal Sulawesi Selatan dan Sulawesi Tenggara. Untuk mendapatkan informasi tersebut, sebanyak 61 isolat asal Sulawesi Selatan dan 29 isolat asal Sulawesi Tenggara dievaluasi kelompok patotipenya pada lima varietas padi diferensial. Hasil penelitian menunjukkan di Sulawesi Selatan ditemukan dua kelompok patotipe yaitu patotipe IV sebanyak 32.79% dan patotipe VIII sebanyak 67.21%, patotipe VIII menyebar luas di wilayah bagian barat dan tengah daratan Sulawesi Selatan, sementara patotipe IV menyebar luas di wilayah bagian selatan. Di Sulawesi Tenggara ditemukan lima patotipe yaitu patotipe IV (27.58%), VI (10.34%), VIII (13.79%), IX (20.68%), dan X (27.58%), dengan pola sebaran yang terbatas dan terpencar di beberapa wilayah. Hasil tersebut mengindikasikan bahwa kelompok patotipe *Xanthomonas oryzae* pv. *oryzae* di Sulawesi Selatan dan Tenggara beragam dan cenderung bergeser ke arah patotipe yang lebih virulen.

Kata kunci : Hawar daun bakteri, kelompok patotipe, *Xanthomonas oryzae pv. oryzae*

**INTRODUCTION**

Bacterial leaf blight disease caused by *Xanthomonas oryzae* pv. *Oryzae* (Xoo) is one of the main diseases of rice in Indonesia (Hifni and Kardin 1998, Semangun 2004), and in other rice-producing countries such as Japan, India and Philiphine (OEPP/EPPO 2007). In Indonesia, the disease could cause yield loss around 20-30% (Kadir *et. al*., 2007), or even 70-80% on susceptible varieties during rainy season (Kadir, 1999).

Several studies have shown the variability of Xoo pathotypes or strains in rice-producing countries (Suparyono *et. al*., 2004; Muneer *et. al*., 2007; Keshavarz *et al*., 2011). The shifting of Xoo pathotypes in Indonesia constantly occures. Yamamoto *et al*. (1977) *in* Kadir (1999), reported that the dominant Xoo pathotypes found in rice fields in Indonesia were pathotypes III, IV and V. Research conducted in 1980s found that pathotypes III, VI, and VIII were the dominant pathotypes (Suparyono, 1984), and during rainy season in the years 1999/2000, it was found pathotypes III, IV and VIII in West Java, Central Java, and Jogyakarta (Suparyono *et al.,* 2004). Based on Kozaka system, there have currently 12 Xoo pathotype groups been found in Indonesia, with different levels of virulence. In line with the overtime shifting of Xoo pathotypes in the fields, the efficiency of using resistant varieties is only temporarily and limited to certain areas, because the initially non-outstanding pathotypes can become outstanding pathotypes when the host is suitable.

The spread of bacterial leaf blight disease on a few areas in Indonesia in recent years is believed due to the shift of Xoo pathotypes that becomes more virulent, the availability of susceptible hosts, and the suitability of climate conditions in the fields. Therefore, information on the distribution of Xoo pathotypes on certain areas is very important in designing the disease control strategy and developing rice varieties thar resistant to the bacterial leaf blight disease. This research aimed to determine the Xoo pathotype groups and their distribution over several rice planting areas in South Sulawesi and Southeast Sulawesi.

**MATERIALS AND METHODS**

**Sample Collection of Rice Leaves Showing the Symptom of Bacterial Leaf Blight**

Sample collection was conducted over several rice planting locations over South and Southeast Sulawesi, during rainy season in 2011. In South Sulawesi, the samples were collected from 11 districts, namely districts Gowa, Takalar, Bantaeng, Jenneponto, Bantaeng, Bulukumba, Sinjai, Bone, Soppeng, Wajo, Sidrap, Pinrang, Barru, Pangkep and Maros. In Southeast Sulawesi, the samples were taken from districts Kolaka, Konawe and South Konawe. Samples were randomly collected over rice planting areas by taking several leaf samples showing bacterial leaf blight symptoms. The leaf samples were put in plastic bags labeled with sampling date, location, and plant growth stage. Samples were transported to the laboratory for further examinations.

**Isolation of *Xanthomonas oryzae* pv. *oryzae***

Isolation of Xoo from leaf tissues was performed by slicing the infected rice leaves by 0.5 cm x 0.5 cm over leaf area located between infected tissue and healthy tissue. The leaf pieces were sterilized in 70% ethanol for 5 minutes, and then rinsed twice with sterile aquadest. The leaf pieces were then chopped with sterile blade, added with 2 drops of sterile aquadest, and incubated for 5 minutes. The supernant containing bacterial cells from chopped leaves was streaked over Wakimoto medium, and then incubated in room temperature for 2-4 days.

Grown Bacterial colonies and showing Xoo characteristics (round colonies, mucoid and yellowish) were purified using a quadrant streak method on PSA medium (Potato 30 gr, Sucrosa 20 gr and Agar 20 gr per liter), and incubated for 3-4 days. Purified isolates were kept in PSA medium in *eppendorf* containing 15% sterile glycerol, stored at – 20°C further tests.

**Biochemical and Physiological Tests**

Biochemical and physiological tests were conducted to make sure that the isolates were Xoo isolates. The tests performed were a gram test with KOH 3%, oksidative-fermentative test, starch hydrolysis test (Kerr, 1980 *in* Rasminah *et al*., 2010), and sensitivity test to Cu(NO3)2 (Djatmiko and Prakoso, 2010).

**Inoculation of *Xanthomonas oryzae* pv. *oryzae* on Differential Varieties**

Determination of Xoo pathotypes was based on Kozaka system developed in Indonesia. The test was conducted in a glasshouse using 5 differential varieties namely: Kencana, PB5, Tetep, Kuntulan and Jawa 14 (Yamamoto *at. al* 1977). Tested isolates were isolates that were positive for Xoo based on biochemical and physiological tests. Seeds of the 5 differential rice varieties were germinated in plastic boxes containing media mixture of topsoil, rice hull, and organic matter (animal feces) (2:2:1). After 21 days, rice seedlings were moved to 35-cm polybags, one seedling per polybag, and then maintained in a screen house.

Xoo inoculation on tested plants was conducted using a “scissoring method”. A sterile scissor was dipped in inoculum suspension (concentration 108 - 109 per ml) and used to cut leaves about 3 cm from leaf tip, on 5 top fully-opened leaf samples. Each Xoo isolate was tested on 2 rice clusters per variety. Observation of disease severity was based on the development of bacterial leaf blight symptoms on inoculated leaves, 14 to 21 days after inoculation.

**Observation of Disease Severity and Determination of Pathotype**

Disease severity was scored by measuring the ratio between the length of leaves with symptom and the length of overall leaves, stated in percentatge (%). Reaction of individual plant to each isolate tested was categorized resistant if disease severity <10%, and susceptible if disease severity >10%. Determination of pathotype was based on a reciprocal relationship between differential varieties and isolates tested, as shown in Table 1.

Table 1. Pathotype grouping of *Xanthomonas oryzae* pv. *oryzae* isolates

based on their reaction to five differential rice varieties

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Differential  Varieties | Pathotype group of *X. oryzae* pv. *oryzae* | | | | | | | | | |
| I | II | III | IV | V | VI | VII | VIII | IX | X |
| Kencana | S | S | S | S | S | S | S | S | S | S |
| PB5 | R | S | S | S | R | R | S | S | S | R |
| Tetep | R | R | S | S | R | S | S | S | R | S |
| Kuntulan | R | R | R | S | S | R | R | S | S | S |
| Jawa 14 | R | R | R | S | R | R | S | R | R | R |

S= susceptible (disease severity >10%), R= resistant (disease severity <10% )

Source: Yamamoto (1977) *in* Kadir (1999)

**RESULTS AND DISCUSSION**

***Xanthomonas oryzae* pv. *oryzae* Isolates from South Sulawesi and Southeast Sulawesi**

Isolation of rice leaves having bacterial leaf blight symptoms resulted in 124 isolates (70 isolates from South Sulawesi and 54 isolates from Southeast Sulawesi) with Xanthomonas characteristics on Wakimoto medium, such as small rounded colonies, mucoid, and yellow in color. Results of biochemical and physiological tests on the 124 isolates indicated that 90 isolates (61 from South Sulawesi and 29 isolates from Southeast Sulawesi) were positive for Xoo, because they had physiological characteristics as shown in Table 2.

Table 2. Characteristic of *X. oryzae* pv*. oryzae* patotipe based on bacteriological test

|  |  |  |
| --- | --- | --- |
| Tests | Characteristic of *X. oryzae* pv*. oryzae* | |
| Test of KOH 3%  Oxidase test  Fluorescence on King’s B medium  Oxidative/Fermentative of Glucose  Starch hydrolysis  Sensitivity to 0.0001% of Cu(NO3)2 | | Gram negative  -  -  oxidative  -  + |

Note : + = positive (growth), - = negative

Results of biochemical and physiological tests showed that not all isolates were Xoo eventhough they grew on Wakimoto medium and yellow in color. Out of 70 isolates from South Sulawesi, only 61 isolates (87.14%) had Xoo criteria, while only 55.56% out of 54 isolates from Southeast Sulawesi that were positive for Xoo.The low percentage of Xoo positive isolates from Southeast Sulawesi was partly due to the less development of the leaf blight symptoms, causing the difficulty in pathogen isolation. In South Sulawesi, however, the disease severity was high and the symptoms were obvious and specific, therefore the pathogen isolation was less difficult.

Xoo isolates were selected if they met the Xoo criteria, including gram negative reaction, oxidative, unfluorescence on King’s B medium, unable to hydrolyze starch, but can grow on PSA medium containing 0.001% Cu(NO3)2. Liu *et. al*. (2006) mentioned that one difference between Xoo causing *bacterial leaf blight* and *X. oryzae* pv. *oryzacola* causing *bacterial leaf streak* was its resistance to 0.001% Cu(NO3)2.. Xoo isolates, that grew on PSA medium containing 0.001% Cu(NO3)2,  showed good growth and had yellow colonies. The 90 Xoo isolates collected and their geographic origins were shown in Table 3

**Pathotype Grouping of *Xanthomonas oryzae* pv. *oryzae***

Pathotype grouping of 90 isolates positive for Xoo was shown in Table 3. Out of 61 Xoo positive isolates from South Sulawesi, there were grouped into 2 pathotypes: patotype IV (32.79%) and pathotype VIII (67.21%). Xoo positive isolates from Southeast Sulawesi were grouped into 5 different pathotypes: pathotype IV (31.03%), pathotype VI (10.34%), pathotype VIII (10.34%), pathotype IX (20.70%), and pathotype X (27.59%).

Table 3. Pathotype groups of *X. oryzae* pv. *oryzae* isolates from South Sulawesi and Southeast

Sulawesi

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Code of  Isolate | Location  (Sub District, District) | Disease Severity (%) on Variety | | | | | | | | | | Pathotype  Group |
| Kencana | | PB5 | | Tetep | | Kuntulan | | Jawa 14 | |
| XSG01 | Bajeng, Gowa | 35.20 | S | 35.25 | S | 33.35 | S | 32.25 | S | 25.45 | S | IV |
| XSG02 | Bontonompo, Gowa | 43.45 | S | 32.25 | S | 35.50 | S | 30.45 | S | 21.45 | S | IV |
| XSG03 | Bontonompo Selatan, Gowa | 42.25 | S | 37.25 | S | 35.50 | S | 25.13 | S | 25.25 | S | IV |
| XSG04 | Bajeng Barat, Gowa | 37.50 | S | 35.50 | S | 35.50 | S | 22.50 | S | 25.13 | S | IV |
| XST05 | Pattalassang, Takalar | 40.25 | S | 35.50 | S | 33.50 | S | 35.25 | S | 34.35 | S | IV |
| XST06 | Mapakasumbu, Takalar | 37.25 | S | 35.50 | S | 30.25 | S | 32.25 | S | 35.25 | S | IV |
| XST07 | Mangarabombang, Takalar | 35.50 | S | 33.50 | S | 35.25 | S | 21.35 | S | 22.25 | S | IV |
| XST08 | Galesong Utara, Takalar | 35.50 | S | 35.25 | S | 32.25 | S | 15.50 | S | 17.25 | S | IV |
| XST09 | Galesong Utara, Takalar | 35.50 | S | 34.25 | S | 25.45 | S | 17.75 | S | 15.50 | S | IV |
| XST10 | Galesong Selatan, Takalar | 33.50 | S | 34.13 | S | 21.45 | S | 18.27 | S | 25.50 | S | IV |
| XSJ11 | Tarowang, Jeneponto | 45.20 | S | 35.25 | S | 25.25 | S | 35.25 | S | 15.50 | S | IV |
| XSJ12 | Arungkeke, Jeneponto | 45.35 | S | 32.25 | S | 25.13 | S | 32.25 | S | 23.50 | S | IV |
| XSJ13 | Batang, Jeneponto | 45.25 | S | 35.50 | S | 35.25 | S | 37.25 | S | 5.25 | T | VIII |
| XSB14 | Lamalaka, Bantaeng | 35.35 | S | 35.50 | S | 32.25 | S | 35.50 | S | 3.25 | T | VIII |
| XSB15 | Pa’jukukang, Bantaeng | 37.25 | S | 35.50 | S | 37.25 | S | 35.50 | S | 5.50 | R | VIII |
| XSB16 | Bissapu, Bantaeng | 35.50 | S | 33.50 | S | 35.50 | S | 35.50 | S | 23.13 | S | IV |
| XSB17 | Gantaran Kenkeng, Bantaeng | 37.25 | S | 33.25 | S | 35.50 | S | 33.50 | S | 21.35 | S | IV |
| XSBK18 | Ujung Loe, Bulukumba | 37.50 | S | 35.25 | S | 35.50 | S | 25.45 | S | 25.25 | S | IV |
| XSBK19 | Rilau Ale, Bulukumba | 37.00 | S | 32.25 | S | 33.50 | S | 21.45 | S | 23.25 | S | IV |
| XSBK20 | Bulukumpa, Bulukumba | 37.13 | S | 25.45 | S | 35.25 | S | 25.25 | S | 2.25 | T | VIII |
| XSBK21 | Bulukumpa, Bulukumba | 35.25 | S | 21.45 | S | 32.25 | S | 25.13 | S | 35.25 | S | IV |
| XSS22 | Sinjai Selatan, Sinjai | 32.25 | S | 25.25 | S | 25.45 | S | 35.25 | S | 32.25 | S | IV |
| XSS23 | Sinjai Selatan, Sinjai | 33.25 | S | 25.13 | S | 21.45 | S | 32.25 | S | 23.20 | S | IV |
| XSS24 | Sinjai Utara, Sinjai | 35.75 | S | 30.25 | S | 25.25 | S | 20.45 | S | 25.72 | S | IV |
| XSSP25 | Lilirilau, Soppeng | 35.13 | S | 27.65 | S | 25.13 | S | 25.13 | S | 1.50 | R | VIII |
| XSSP26 | Lilirilau, Soppeng | 34.13 | S | 35.25 | S | 25.25 | S | 35.25 | S | 0.90 | R | VIII |
| XSSP27 | Liliriaja, Soppeng | 33.50 | S | 32.25 | S | 25.13 | S | 32.25 | S | 2.45 | R | VIII |
| XSM28 | Simbang, Maros | 45.50 | S | 35.23 | S | 35.25 | S | 27.55 | S | 2.15 | R | VIII |
| XSM29 | Simbang, Maros | 42.25 | S | 30.45 | S | 32.25 | S | 19.45 | S | 0.70 | R | VIII |
| XSM30 | BanRimurung, Maros | 45.45 | S | 31.25 | S | 35.25 | S | 35.25 | S | 0.90 | R | VIII |
| XSM31 | BanRimurung, Maros | 35.25 | S | 25.75 | S | 32.25 | S | 32.25 | S | 1.15 | R | VIII |
| XSM32 | Turilake, Maros | 35.75 | S | 25.25 | S | 37.25 | S | 25.45 | S | 1.25 | R | VIII |
| XSM33 | Turikale, Maros | 37.13 | S | 25.13 | S | 35.50 | S | 21.45 | S | 1.75 | R | VIII |
| XSB34 | Lamuru, Bone | 33.25 | S | 35.25 | S | 35.50 | S | 25.25 | S | 4.35 | R | VIII |
| XSP35 | Tiroang, Pinrang | 35.13 | S | 32.25 | S | 35.50 | S | 25.13 | S | 3.22 | R | VIII |
| XSP36 | Tiroang, Pinrang | 37.25 | S | 35.25 | S | 33.50 | S | 32.25 | S | 2.50 | R | VIII |
| XSP37 | Suppa, Pinrang | 40.13 | S | 32.25 | S | 25.25 | S | 37.25 | S | 2.56 | R | VIII |
| XSSR38 | Maritengae, Sidrap | 40.25 | S | 37.25 | S | 35.25 | S | 35.50 | S | 3.00 | R | VIII |
| XSSR39 | Dua Pitue, Sidrap | 42.13 | S | 35.50 | S | 32.25 | S | 35.50 | S | 2.45 | R | VIII |
| XSSR40 | Dua Pitue, Sidrap | 45.13 | S | 35.50 | S | 25.45 | S | 35.50 | S | 3.25 | R | VIII |
| XSW41 | Tanasitolo, Wajo | 42.50 | S | 35.50 | S | 21.45 | S | 33.50 | S | 4.13 | R | VIII |
| XSW42 | Tanasitolo. Wajo | 37.25 | S | 33.50 | S | 25.25 | S | 22.35 | S | 4.56 | R | VIII |
| XSW43 | Sabbangparu, Wajo | 37.35 | S | 31.00 | S | 25.13 | S | 25.34 | S | 3.75 | R | VIII |
| XSW44 | Maniangpajo, Wajo | 32.25 | S | 32.45 | S | 27.13 | S | 25.45 | S | 2.35 | R | VIII |
| XSBR45 | Balusu, Barru | 33.45 | S | 30.35 | S | 25.45 | S | 25.50 | S | 3.45 | R | VIII |
| XSBR46 | Balusu, Barru | 33.25 | S | 27.35 | S | 21.45 | S | 22.45 | S | 2.35 | R | VIII |
| XSBR47 | Barru, Barru | 40.25 | S | 38.55 | S | 25.25 | S | 25.25 | S | 3.55 | R | VIII |
| XSBR48 | Barru, Barru | 35.13 | S | 36.00 | S | 25.13 | S | 23.25 | S | 2.45 | R | VIII |
| XSBR49 | Barru, Barru | 35.25 | S | 34.00 | S | 30.00 | S | 20.30 | S | 3.45 | R | VIII |
| XSBR51 | Mallusetasi, Barru | 37.13 | S | 26.85 | S | 21.45 | S | 23.13 | S | 1.75 | R | VIII |
| XSBR52 | Mallusetasi, Barru | 35.75 | S | 30.00 | S | 25.25 | S | 22.30 | S | 2.35 | R | VIII |
| XSBR53 | Soppengriaja, Barru | 35.25 | S | 32.15 | S | 26.35 | S | 19.30 | S | 1.75 | R | VIII |
| XSBR54 | Soppengriaja, Barru | 34.13 | S | 25.13 | S | 27.13 | S | 23.25 | S | 2.45 | R | VIII |
| XSPK55 | Labakkang, Pangkep | 45.23 | S | 27.50 | S | 25.13 | S | 21.20 | S | 1.50 | R | VIII |
| XSPK56 | Labakkang, Pangkep | 43.25 | S | 40.25 | S | 35.67 | S | 35.75 | S | 5.50 | R | VIII |
| XSPK57 | Mandalle, Pangkep | 37.25 | S | 35.33 | S | 23.13 | S | 22.30 | S | 2.35 | R | VIII |

Table 3… (continued)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Isolate  Code | | Origin  (Sub District, District) | Disease Severity (%) on Variety | | | | | | | | | | Pathotype  Group |
| Kencana | | PB5 | | Tetep | | Kuntulan | | Jawa 14 | |
| XSPK58 | Bungoro, Pangkep | | 42.13 | S | 27.25 | S | 21.35 | S | 21.35 | S | 2.50 | R | VIII |
| XSPK59 | Minasatene’, Pangkep | | 40.13 | S | 36.00 | S | 25.25 | S | 25.25 | S | 1.50 | R | VIII |
| XSPK60 | Ma’rang, Pangkep | | 45.25 | S | 35.35 | S | 23.25 | S | 23.13 | S | 2.50 | R | VIII |
| XSPK61 | Segeri, Pangkep | | 37.13 | S | 27.50 | S | 30.25 | S | 21.35 | S | 2.50 | R | VIII |
| XTKL01 | Samaturu, Kolaka | | 15.51 | S | 11.17 | S | 21.45 | S | 40.43 | S | 7.06 | R | VIII |
| XTKL02 | Samaturu, Kolaka | | 25.55 | S | 4.71 | R | 73.09 | S | 27.50 | S | 9.67 | R | X |
| XTKL03 | Samaturu, Kolaka | | 25.17 | S | 2.60 | R | 31.23 | S | 3.85 | R | 7.89 | R | VI |
| XTKL04 | Wolo, Kolaka | | 63.86 | S | 5.06 | R | 29.76 | S | 73.58 | S | 7.11 | R | X |
| XTKL05 | Wundulako, Kolaka | | 21.14 | S | 2.41 | R | 10.95 | S | 30.85 | S | 0.59 | R | X |
| XTKL06 | Wundulako, Kolaka | | 39.06 | S | 40.02 | S | 16.77 | S | 36.69 | S | 44.97 | S | IV |
| XTKL07 | Pomalaa, Kolaka | | 20.72 | S | 4.72 | R | 25.15 | S | 35.88 | S | 7.16 | R | X |
| XTKL08 | Ladongi, Kolaka | | 24,62 | S | 4.72 | R | 25.15 | S | 35.88 | S | 6.16 | R | X |
| XTKW09 | Wonggeduku, Konawe | | 24.72 | S | 4.78 | R | 25.15 | S | 35.88 | S | 7.79 | R | X |
| XTKW10 | Tongauna, Konawe | | 40.75 | S | 3.20 | R | 44.06 | S | 25.09 | S | 8.81 | S | X |
| XTKW11 | Tongauna, Konawe | | 31.33 | S | 41.74 | S | 43.09 | S | 59.72 | S | 48.71 | S | IV |
| XTKW12 | Tongauna, Konawe | | 31.68 | S | 41.74 | S | 43.62 | S | 56.42 | S | 46.81 | S | IV |
| XTKW13 | Tongauna, Konawe | | 22.70 | S | 9.79 | R | 14.53 | S | 2.97 | R | 3.87 | R | VI |
| XTKW14 | Uepai, Konawe | | 53.87 | S | 5.82 | R | 17.02 | S | 37.34 | S | 8.91 | R | X |
| XTKW15 | Wawotobi, Konawe | | 17.91 | S | 18.87 | S | 6.44 | R | 5.92 | R | 6.08 | R | IX |
| XTKW16 | Unaaha, Konawe | | 35.50 | S | 2.57 | R | 60.28 | S | 1.51 | R | 2.09 | R | IV |
| XTKW17 | Wonggedeku, Konawe | | 67.68 | S | 84.40 | S | 71.86 | S | 55.11 | S | 46.10 | S | IV |
| XTKS18 | Landono, Konawe Selatan | | 57.57 | S | 51.09 | S | 3.25 | R | 47.21 | S | 3.86 | R | IX |
| XTKS19 | Landono, Konawe Selatan | | 64.86 | S | 89.99 | S | 97.60 | S | 94.33 | S | 6.21 | R | VIII |
| XTKS20 | Landono, Konawe Selatan | | 28.37 | S | 37.30 | S | 58.09 | S | 41.53 | S | 16.98 | S | IV |
| XTKS21 | Laea, Konawe Selatan | | 13.57 | S | 11.90 | S | 33.79 | S | 26.63 | S | 10.85 | S | IV |
| XTKS22 | Palangga, Konawe Selatan | | 24.70 | S | 67.05 | S | 37.60 | S | 18.08 | S | 5.85 | R | VIII |
| XTKS23 | Palangga, Konawe Selatan | | 19.76 | S | 10.10 | S | 60.41 | S | 52.46 | S | 22.82 | S | IV |
| XTKS24 | Palangga, Konawe Selatan | | 83.21 | S | 31.93 | S | 63.41 | S | 44.52 | S | 34.44 | S | IV |
| XTKS25 | Palangga, Konawe Selatan | | 37.84 | S | 42.96 | S | 77.57 | S | 42.06 | S | 3.07 | R | VIII |
| XTKS26 | Lainea, Konawe Selatan | | 41.93 | S | 32.52 | S | 4.61 | R | 10.78 | S | 1.21 | R | IX |
| XTKS27 | Lainea, Konawe Selatan | | 19.19 | S | 14.84 | S | 5.58 | R | 16.77 | S | 6.14 | R | IX |
| XTKS28 | Laea, Konawe Selatan | | 15.06 | S | 10.33 | S | 7.51 | R | 50.21 | S | 2.11 | R | IX |
| XTKS29 | Laea, Konawe Selatan | | 17.07 | S | 11.53 | S | 7.61 | R | 50.01 | S | 2.81 | R | IX |

Note:S = susceptible, R = resistant

The results of pathotype grouping indicated that the dominant pathotypes in South Sulawesi were pathotypes IV and VIII, while in Southeast Sulawesi were pathotypes IV and X. The dominance of pathotypes IV and VIII in South Sulawesi was similar to the report by Suparyono (2004), who found the same 2 dominant pathotypes in West Java, Central Java, and Jogjakarta. Hifni (1986) previously mentioned that the dominant Xoo pathotype in Indonesia was pathotype III, while Suryadi dan Machmud (1987) reported that the dominant Xoo pathotype in Districts Kerawang and Bekasi was pathotype VI. With the current dominance of pathotypes IV and VIII, this indicates that there has been a shift in Xoo pathotypes towards more virulent pathotypes in several areas in Indonesia.

There was a clear distribution pattern of Xoo pathotypes in South Sulawesi. Pathotype IV was widely distributed in Southern areas of South Sulawesi, such as Districts Gowa, Takalar, Bantaeng, Jeneponto, Bulukumba, and Sinjai. On the other hand, pathotype VIII occurred in Western and Central areas, such as Districts Maros, Pangkep, Barru, Pinrang, Sidrap, Wajo, Soppeng, and Bone. Pathotype VIII was also found in Districts Bantaeng, Jeneponto and Bulukumba.

Although the surveyed areas were still quite limited, the research results indicated that Xoo pathotypes distributed in South Sulawesi were not too diverse since there were only two pathotypes found. The pathotype distribution seemed to be in line with the geographic distribution, indicating that a wide area was dominated by a certain pathotype. The distribution pattern of Xoo pathotypes in Southeast Sulawesi was quite different from that of in South Sulawesi. In Southeast Sulawesi, the pathotype distribution was concentrated in certain locations. However, sometime between near locations there were different pathotype groups, therefore within a single district there was sometime found two different pathotype groups. Xoo pathotype distribution in South and Southeast Sulawesi was shown in Table 4.

The difference in the distribution pattern of Xoo pathotype groups between the two provinces was probably caused by several factors, such as: (1) the rice planting areas, in certain locations, in Southeast Sulawesi were generally much narrower that the planting areas in South Sulawesi, (2) irrigation system of rice planting areas in South Sulawesi was much better and more developed than that of in Southeast Sulawesi. The irrigation system could be a good media for the spread of a certain pathotype group over wide areas. While patchy planting areas (separated by forest, villages, etc), which were mostly found in Southeast Sulawesi, usually resulted in relatively limited pathotype distribution, (3) the more uniform rice varieties grown in wide areas in South Sulawesi, while in Southeast Sulawesi the rice varieties used were relatively more diverse. Suparyono *et. al.* (2004), mentioned that one factor causing more variable Xoo pathotypes in certain locations was the diversity of varieties grown in those locations.

Table 4. Geographic distribution of pathotype groups of *X. oryzae* pv. *oryzae* in

South Sulawesi and Southeast Sulawesi

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Location of  Distribution | Pathotype Group | | | | | Total  Isolates |
| IV | VI | VIII | IX | X |
| **South Sulawesi** | **20 (32.79)** | **0** | **41 (67.21)** | **0** | **0** | **61** |
| Gowa | 4 (100) | 0 | 0 | 0 | 0 | 4 |
| Takalar | 6 (100) | 0 | 0 | 0 | 0 | 6 |
| Jeneponto | 2 (66) | 0 | 1 (34) | 0 | 0 | 3 |
| Bantaeng | 2 (50) | 0 | 2 (50) | 0 | 0 | 4 |
| Bulukumba | 3 (75) | 0 | 1 (25) | 0 | 0 | 4 |
| Sinjai | 3 (100) | 0 | 0 | 0 | 0 | 3 |
| Bone | 0 | 0 | 1 | 0 | 0 | 1 |
| Soppeng | 0 | 0 | 3 (100) | 0 | 0 | 3 |
| Wajo | 0 | 0 | 4 (100) | 0 | 0 | 4 |
| Sidrap | 0 | 0 | 3 (100) | 0 | 0 | 3 |
| Pinrang | 0 | 0 | 3 (100) | 0 | 0 | 3 |
| Barru | 0 | 0 | 10 (100) | 0 | 0 | 10 |
| Pangkep | 0 | 0 | 7 (100) | 0 | 0 | 7 |
| Maros | 0 | 0 | 6 (100) | 0 | 0 | 6 |
|  |  |  |  |  |  |  |
| **Southeast Sulawesi** | **8 (27.58)** | **3 (10.34)** | **4 (13.79)** | **6 (20.68)** | **8 (27.58)** | **29** |
| Kolaka | 1 (12.50) | 1 (12.50) | 1 (12.50) | 0 | 5 (62,50) | 8 |
| Konawe | 3 (33.33) | 2 (22.22) | 0 | 1 (11.11) | 3 (33.33) | 9 |
| Konawe Selatan | 4 (33.33) | 0 | 3 (25) | 5 (41.67) | 0 | 12 |

**CONCLUSION**

Pathotype grouping of *Xanthomonas oryzae* pv. *oryzae* isolated from rice plants planted in South Sulawesi and Southeast Sulawesi during rainy season 2011 resulted in 5 (five) pathotype groups. It was found 2 pathotype groups in South Sulawesi, namely pathotype IV (32.79%) and pathotype VIII (67.21%). Pathotype VIII was widely distributed over the Western and Central areas of South Sulawesi, whereas pathotype IV was widely distributed over the Southern area. In Southeast Sulawesi, it was found 5 pathotypes, namely pathotypes IV (27.58%), VI (10.34%), VIII (13.79%), IX (20.68%), and X (27.58%), with a limited and scattered distribution pattern on several areas. These results indicate that Xoo pathotype groups in South Sulawesi and Southeast Sulawesi are varied and tend to sift to more virulent pathotypes.

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