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RESISTANCE CHARACTERIZATION OF WILD RELATIVES OF RICE IN RESPONSE TO BACTERIAL BLIGHT

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Abstract

Bacterial blight (BB) of rice caused by *Xanthomonas oryzae* pv. *oryzae* is becoming a potential threat to rice crop in many regions of the world. In order to identify resistant sources to virulent isolates of bacterial blight, an experiment comprising 14 species of wild rice (*Oryza* sp.) and three widely used cultivated varieties of rice in Pakistan was conducted in the greenhouse of National Agricultural Research Centre, Islamabad during 2005. Adult plants were inoculated with virulent isolates of *Xanthomonas oryzae* pv. *oryzae* prevailing in NWFP, Pakistan i.e., Xo-103, Xo-107, Xo-139, Xo-143, Xo-304, Xo-351 and MNR-4. Of all the wild relatives of rice, *O. nivara*, *O. longistaminata* and *O. grandiglumis* showed resistance to all isolates. *O. nivara* even didn't show any lesion against any isolate. Remaining wild species showed differential response to the isolates used in the study. These species were resistant to one or few isolates but expressed susceptibility to others. Bas-385, IR-6 and KSK-282, the cultivated varieties of Pakistan used in study were found susceptible to most of the isolates. The use of resistant wild species *O. nivara*, *O. longistaminata* and *O. grandiglumis* is, therefore, recommended in rice breeding programs for transfer of bacterial blight resistant genes to cultivated varieties.

Introduction

The rice crop is susceptible to a number of diseases among which bacterial blight (BB) of rice caused by *Xanthomonas oryzae* pv. *oryzae* (Ishiyama, 1922; Swing *et al*., 1990) is the most destructive disease of rice throughout the world (Mew, 1987). This disease was initially observed by farmers in Japan during 1884-85 and its occurrence has been reported in Australia, Bangladesh, India, Mainland China, Malaysia, Sri Lanka, Thailand, The Philippines, USA, West Africa and Vietnam (Ezuka & Kaku, 2000). Mew & Majid (1977) reported its incidence in Pakistan and its occurrence was confirmed from all the provinces in a later study (Akhtar & Akram, 1987). Recent studies have indicated an alarming increase in BB incidence in Pakistan especially in "Kaller" belt which is famous for rice cultivation (Khan *et al*., 2000 & Akhtar *et al*., 2003).

BB occurs at all growth stages of rice and is manifested by either leaf blight or "Kresek" symptoms. The causal organism invades plants through water pores and wounds (Mizukami, 1956; Tabei & Mukoo, 1960). Since the water pores are located at the margins of upper parts of the leaf, the lesion starts from the leaf margins near its tip. As the disease progresses, the tiny water soaked lesions turns yellow, enlarges in size progressively and develop into an elongated irregular lesion with wavy margins. Bacterial ooze, which consists of small, yellowish, spherical masses, may sometimes be seen on the margins or veins of the freshly infected leaf under moist conditions. With passage of time, the lesion may cover the entire blade, which turns white and later grayish owing saprophytic growth (Tagami & Mizukami 1962, OCTA, 1970; Ou, 1985). If plant ever produces panicles, it results in sterile immature grains, which are easily broken during milling. The reduction in yield in case of severe infection could be as high as 50% (Mew *et al.*, 1993) whereas 10-12% yield reduction has been recorded in case of mild infection (Ou, 1985). The disease is also characterized by a systemic infection phase, which is manifested by acute wilting of young plants. This is commonly referred to as “Kresek” phase (Reitsma & Schure, 1950). The causal organism consists of straight rods, with a single polar flagellum, occurring singularly, in pairs and sometimes in chains as well and is also Gram- negative (Swings *et al.*, 1990). The bacterium over winters either in weeds or in soil. Grains, straw and rice stubble are other possible sites of over wintering of the pathogen. During growing season, it enters the plants via natural opening or wounds where it survives and multiplies in plant’s vascular system, producing typical leaf blight symptoms.

Bacterial bight has the potential to become a destructive disease of rice in Pakistan. Generally, the use of resistant cultivars is the most effective method for controlling plant diseases. However, the available rice germplasm in the country is susceptible to virulent isolates of bacterial blight (Akhtar, 2005). The present study was, therefore, aimed to identify resistant sources to virulent isolates bacterial blight in wild relatives of rice for future use in rice breeding programs.

Materials and Methods

The experiment was carried out in the greenhouse of Plant Genetic Resources Institute (PGRI), National Agricultural Research Centre (NARC), Islamabad during 2005 rice crop growing season. Germplasm of 14 wild species of rice provided by International Rice Genebank Collection (IRGC), International Rice Research Institute (IRRI), Philippines along with commercial cultivars of rice in Pakistan viz. Bas-385, KSK-282 and IR-6 was used. The list of wild rice species along with their IRGC accession number and source is given in Table 1. Before seeding, seeds of wild relatives of rice were heat treated at 50^{O}C to break their dormancy. Seeding was done on sterilized Petri dishes. Seven days after seeding, seedlings were transplanted into well puddled pots of both length and diameter of 25 cm. To increase the number of plants, cloning of wild relatives was done. Clones derived from the newly arising tillers of existing plants were subsequently transferred into well puddled pots. Each clone later developed into full fledge plant. Adult plants (100 days old) of wild relatives of rice representing different genomes along with commercial rice cultivars were inoculated with virulent isolates of *Xanthomonas oryzae* pv. *oryzae* prevailing in North West Frontier Province (N.W.F.P.), Pakistan i.e., Xo-103, Xo-107, Xo-139, Xo-143, Xo-304, Xo-351 and MNR-4. Isolates Xo-103, Xo-107, Xo-139, Xo-143, Xo-304 and Xo-351 were collected from different rice growing areas of district Swat, whereas source of isolate MNR-4 was rice growing areas of district Manshera. Inoculum was prepared in distilled water. The concentration was adjusted to about 10^8 cfu/ml. The pairs of inoculating scissors were dipped into prepared inoculum placed in flasks wrapped with aluminum foil to protect bacteria from solar heat. For each isolate, two leaves of each wild relative and commercial cultivar were cut at approximately 5 cm from the tips and then lesion lengths were measured fifteen days after inoculation. On the basis of mean lesion size for each isolate, these wild relatives along with commercial cultivars were grouped into different categories of resistance and susceptibility using standard IRRI procedure (Chaudry, 1996).

Table 1. International Rice Genebank Collection (IRGC) accession number and source countries of wild rice species (*Oryza* sp.) used in the study.

Wild rice species	IRGC accession	Source country
O. alta	100161	Brazil
O. australiensis	103303	Australia
O. barthii	100921	India
O. brachyantha	101233	Sierra Leone
O. grandiglumis	105144	Brazil
O. glumaepatula	100184	Cuba
O. latifolia	100966	Panama
O. longistaminata	101200	Nigeria
O. meridionalis	101145	Australia
O. nivara	104644	Thailand
O. officinalis	100954	India
O. punctata	100892	India
O. rhizomatis	103410	Sri Lanka
O. rufipogon	103308	Taiwan

Disease rating	Lesion size (Perecnt of leaf length)	Category
1	0-3	Highly resistant
2	4-6	Resistant
3	7-12	Resistant
4	13-25	Moderately resistant
5	26-50	Moderately susceptible
6	51-75	Susceptible
7	76-87	Susceptible
8	87-94	Highly susceptible
9	95-100	Highly susceptible

Results and Discussion

The response of 14 wild rice species (*Oryza* sp.) along with 3 commercial cultivars of rice in Pakistan was studied against virulent isolates of bacterial blight in NWFP, Pakistan.

***O. alta*:** Mean leaf lesion length data revealed that *O. alta* gave no lesion against the isolates Xo-107, Xo-139, Xo-143, Xo-143, Xo-304 and MNR-4. However, mean leaf lesion lengths of 3 and 9 cm, constituting 11 and 32% of total leaf lengths were observed against the isolates Xo-103 and Xo-351, respectively (Tables 2 and 3). *O. alta* showed resistance against all the isolates except Xo-351 to which this wild species was moderately susceptible (Table 4).

***O. australiensis*:** Inoculation of *O. australiensis* with the isolates Xo-139, Xo-351 and MNR-4 resulted in no lesion on leaves of this wild species. Isolates Xo-103, Xo-107 and Xo-304, however, showed mean leaf lesion lengths of 11, 20, 3.5 and 14 cm, respectively on *O. australiensis* (Table 2). These lesions lengths were 42.2, 90.8, 14.5 and 49% of total leaf lengths, respectively (Table 3). *O. australiensis* was highly resistant against Xo-139, Xo-351 and MNR-4 and displayed moderate resistance against the isolate Xo-143. However, this species was highly susceptible against the isolate Xo-107 and moderately susceptible against the isolates Xo-103 and Xo-304 (Table 4).

Table 2. Mean leaf lesion lengths (cm) of wild species and cultivated varieties of rice in response to *Xanthomonas oryzae* isolates.

Rice genotypes	Xo-103	Xo-107	Xo-139	Xo-143	Xo-304	Xo-351	MNR-4
O. alta	3	NIL	NIL	NIL	NIL	9	NIL
O. australiensis	11	20	NIL	3.5	14	NIL	NIL
O. barthii	18.2	15	11	11.5	5	7.5	6.5
O. brachyantha	4	NIL	1.5	NIL	1.7	1.2	5.7
O. grandiglumis	NIL	NIL	NIL	1	NIL	2	NIL
O. glumaepatula	8	19.5	16.5	25.5	10	19	3.5
O. latifolia	31.5	21.5	NIL	3.5	NIL	NIL	18.3
O. longistaminata	NIL	NIL	NIL	NIL	NIL	NIL	1.7
O. meridionalis	NIL	NIL	27	36.5	8	15.5	NIL
O. nivara	NIL	NIL	NIL	NIL	NIL	NIL	NIL
O. officinalis	2.7	6.5	NIL	23	20	0.6	7.7
O. punctata	7.7	7.5	NIL	7.7	22	5	13.5
O. rhizomatis	2.5	23	NIL	1.25	NIL	18	6
O. rufipogon	NIL	20.5	11.2	21	1.2	25.5	NIL
Bas-385	19	14.5	37	15.5	17.5	19	26.5
IR-6	9.5	22	27	26	35.5	7.5	21
KSK-282	19	14.5	12	7.5	18	9	18.5

Table 3. Lesions as percent of leaf lengths due to *Xanthomonas oryzae* isolates on wild species and cultivated varieties of rice.

Rice genotypes	Xo-103	Xo-107	Xo-139	Xo-143	Xo-304	Xo-351	MNR-4
O. alta	11.0	NIL	NIL	NIL	NIL	32.0	NIL
O. australiensis	42.2	90.8	NIL	14.5	49.0	NIL	NIL
O. barthii	92.5	46.2	40.6	42.6	14.2	29.4	21.4
O. brachyantha	50.0	NIL	22.6	NIL	20.8	15.0	91.7
O. grandiglumis	NIL	NIL	NIL	3.6	NIL	6.2	NIL
O. glumaepatula	20	30	31.1	42.8	28.5	41.8	7.5
O. latifolia	96.7	53.0	NIL	13.2	NIL	NIL	52.2
O. longistaminata	NIL	NIL	NIL	NIL	NIL	NIL	3.2
O. meridionalis	NIL	NIL	96.1	97.1	25.9	36.2	NIL
O. nivara	NIL	NIL	NIL	NIL	NIL	NIL	NIL
O. officinalis	15.2	28.8	NIL	92.0	60.7	5.6	45.7
O. punctata	34.8	40.1	NIL	24.8	58.9	16.1	59.5
O. rhizomatis	12.7	100	NIL	6.5	NIL	85.7	30
O. rufipogon	NIL	58.5	40.1	74.9	3.5	62.8	NIL
Bas-385	44.7	30.4	72.6	37.7	43.6	46.9	54.6
IR-6	24.1	46.6	47.0	51.5	76.3	19.8	52.5
KSK-282	42.2	35.3	30.2	17.2	53.1	23.01	45.8

***O. barthii*:** *O. barthii* gave mean lesion lengths of 18.2, 15, 11, 11.5, 5, 7.5 and 6.5 cm on inoculation with the isolates Xo-103, Xo-107, Xo-139, Xo-143, Xo-304, Xo-351 and MNR-4, respectively (Table 2). These lesion lengths were 92.5, 46.2, 40.6, 42.6, 14.2, 29.4 and 21.4% of their corresponding total leaf lengths, respectively (Table 3). *O. barthii* showed moderate levels of resistances to isolates Xo-304 and MNR-4. It was moderately susceptible to isolates Xo-107, Xo-139, Xo-143 and Xo-351 and highly susceptible to isolate Xo-103 (Table 4).

Table 4. Adult plant response of wild species and cultivated varieties of rice to isolates of *Xanthomonas oryzae*.

Rice genotypes	Xo-103	Xo-107	Xo-139	Xo-143	Xo-304	Xo-351	MNR-4
O. alta	3 (R)	1 (HR)	1 (HR)	1 (HR)	1 (HR)	5 (MS)	1 (HR)
O. australiensis	5 (MS)	8 (HS)	1 (HR)	4 (MR)	5 (MS)	1 (HR)	1 (HR)
O. barthii	8 (HS)	5 (MS)	5 (MS)	5 (MS)	4 (MR)	5 (MS)	4 (MR)
O. brachyantha	5 (MS)	1 (HR)	4 (MR)	1 (HR)	4 (MR)	4 (MR)	8 (HS)
O. grandiglumis	1 (HR)	1 (HR)	1 (HR)	1 (HR)	1 (HR)	2 (R)	1 (HR)
O. glumaepatula	4 (MR)	5 (MS)	5 (MS)	5 (MS)	5 (MS)	5 (MS)	3 (R)
O. latifolia	9 (HS)	6 (S)	1 (HR)	4 (MR)	1 (HR)	1 (HR)	6 (S)
O. longistaminata	1 (HR)	1 (HR)	1 (HR)	1 (HR)	1 (HR)	1 (HR)	1 (HR)
O. meridionalis	1 (HR)	1 (HR)	9 (HS)	9 (HS)	4 (MR)	5 (MS)	1 (HR)
O. nivara	1 (HR)	1 (HR)	1 (HR)	1 (HR)	1 (HR)	1 (HR)	1 (HR)
O. officinalis	4 (MR)	5 (MS)	1 (HR)	8 (HS)	6 (S)	2 (R)	5 (MS)
O. punctata	5 (MS)	5 (MS)	1 (HR)	4 (MR)	6 (S)	4 (MR)	6 (S)
O. rhizomatis	3 (R)	9 (HS)	1 (HR)	2 (R)	1 (HR)	7 (S)	5 (MS)
O. rufipogon	1 (HR)	6 (S)	5 (MS)	6 (S)	1 (HR)	6 (S)	1 (HR)
Bas-385	5 (MS)	5 (MS)	6 (S)	5 (MS)	5 (MS)	5 (MS)	6 (S)
IR-6	4 (MR)	5 (MS)	5 (MS)	6 (S)	7 (S)	4 (MR)	6 (S)
KSK-282	5 (MS)	5 (MS)	5 (MS)	4 (MR)	6 (S)	4 (MR)	5 (MS)

HR=Highly resistant, R=Resistant, MR=Moderately resistant, MS=Moderately susceptible, S=Susceptible, HS=Highly susceptible

O. brachyantha: The data on mean leaf lesion length revealed that *O. brachyantha* showed lesions of 4, 1.5, 1.7, 1.2 and 5.7 cm against the isolates Xo-103, Xo-139, Xo-304, Xo-351 and MNR-4, respectively while not showing any lesion on inoculation with the isolate Xo-107 (Table 2). These lesion lengths constituted 50, 22.6, 20.8, 15 and 91.7% of total leaf lengths, respectively (Table 3). *O. brachyantha* appeared highly resistant against the isolates Xo-107 and Xo-143 and moderately resistant against the isolates Xo-139, Xo-304 and Xo-351. This wild species showed moderate levels of susceptibility to the isolate Xo-103 and high levels of susceptibility to the isolate MNR-4 (Table 4).

O. grandiglumis: Lesions did not appear on leaves of *O. grandiglumis* against the isolates Xo-103, Xo-107, Xo-139, Xo-304 and MNR-4. Isolates Xo-143 and Xo-351, however, produced very minute lesions of 1 and 2 cm making 3.6 and 6.2% of total leaf lengths, respectively (Tables 2 and 3). *O. grandiglumis* showed resistance against all the isolates (Table 4).

O. glumaepatula: *O. glumaepatula* displayed leaf lesions against all the isolates. These mean leaf lesion lengths were of 8, 19.5, 16.5, 25.5, 10, 19 and 3.5 cm against the isolates Xo-103, Xo-107, Xo-139, Xo-143, Xo-304, Xo-351 and MNR-4, respectively (Table 2). Leaf lesions of *O. glumaepatula* were of 20, 30, 31.1, 42.8, 28.5, 41.8 and 7.6% of total leaf lengths against the respective isolates viz. Xo-103, Xo-107, Xo-139, Xo-143, Xo-304, Xo-351 and MNR-4 (Table 3). It was resistant against isolate MNR-4 whereas against isolate Xo-103 it showed resistance of moderate nature. This wild species was, however, moderately susceptible to all other isolates (Table 4).

O. latifolia: *O. latifolia* didn't show any leaf lesion on inoculation with isolates Xo-139, Xo-304 and Xo-351. However, lesions of sizes of 31.5, 21.5, 3.5 and 18.3 cm were observed for isolates Xo-103, Xo-107, Xo-143 and MNR-4, respectively (Table 2). These lesion sizes were of 96.7, 53, 13.2 and 52.2% of total leaf lengths, respectively (Table 3). *O. latifolia* appeared highly resistant against isolates Xo-139, Xo-304 and Xo-351 and moderately resistant against Xo-143. It was, however, susceptible to all other isolates (Table 4).

O. longistaminata**:** Only one isolate MNR-4 had a small lesion of 1.5 cm constituting only 3.2% of leaf length on leaves of *O. longistaminata*. The remaining isolates didn't produce lesions on leaves of this species (Tables 2 and 3). *O. longistaminata* appeared resistant against all the isolates (Table 4).

O. meridionalis**:** Lesions didn't appear on leaves of *O. meridionalis* on inoculation with isolates Xo-103, Xo-107 and MNR-4. However, isolates Xo-139, Xo-143, Xo-304 and Xo-351 did produce lesions of 27, 36.5, 8 and 15.5 cm which were 96.1, 97.1, 25.9 and 36.2% of their leaf lengths (Tables 2 and 3). *O. meridionalis* manifested high levels of resistance against isolates Xo-103, Xo-107 and MNR-4 and moderate resistance to isolate Xo-304. Against other isolates this species seemed susceptible (Table 4).

O. nivara**:** None of the isolates produced any lesion on leaves of *O. nivara* and this species showed high levels of resistance against all the isolates (Tables 2, 3and 4).

O. officinalis**:** *O. officinalis* showed mean lesion lengths of 2.7, 6.5, 23, 20, 0.6 and 7.7 cm against isolates Xo-103, Xo-107, Xo-143, Xo-304, Xo-351 and MNR-4, respectively. These lesions were of 15.2, 28.8, 92, 60.7, 5.6 and 45.7% of leaf lengths. However, no lesion was observed on inoculation with isolate Xo-139 (Tables 2 and 3). This species showed good levels of resistance against isolates Xo-139 and Xo-351 and moderate resistance against Xo-103. It was susceptible to all other isolates (Table 4).

O. punctata**:** Isolates Xo-103, Xo-107, Xo-143, Xo-304, Xo-351 and MNR-4 produced lesions of 7.7, 7.5, 22, 5 and 13.5 cm constituting 34.8, 40.1, 24.8, 58.9, 16.15 and 59.5% of leaf lengths, respectively on *O. punctata*. However, isolates Xo-139 didn't manifest any lesion on leaves of this wild species (Tables 2 and 3). *O. punctata* appeared highly resistant against the isolate Xo-139, while moderately resistant against Xo-143 and Xo-351. It showed susceptibility to all other isolates (Table 4).

O. rhizomatis**:** Isolates Xo-139 and Xo-304 didn't produce any lesion on leaves of *O. rhizomatis*. However, lesion lengths of 2.5, 23, 1.25 and 25.5 cm appeared on inoculation with isolates Xo-103, Xo-107, Xo-143, Xo-351 and MNR-4, respectively. These lesions were 12.7, 100, 6.5, 85.7 and 30% of leaf lengths, respectively (Tables 2 and 3). *O. rhizomatis* showed good resistance against isolates Xo-103, Xo-139, Xo-143 and X-304, whereas it was susceptible to all other isolates (Table 4).

O. rufipogon**:** *O. rufipogon* didn't show any lesion in response to inoculation with isolates Xo-103 and MNR-4. However, lesions of 20.5, 11.2, 21, 1.2 and 25.5 cm making 58.5, 40.1, 74.9, 3.5 and 62.8% of leaf lengths appeared on inoculation with isolates Xo-107, Xo-139, Xo-143, Xo-304, Xo-351 and MNR-4, respectively (Table 2 and 3). This species was highly resistant against isolates Xo-103, Xo-304 and MNR-4 and against others, it was susceptible (Table 4).

Commercial rice cultivars: Bas-385, IR-6 and KSK-282 are the three widely cultivated varieties of rice in Pakistan. These cultivars produced lesions against all the isolates. Data revealed lesion lengths of 19, 14.5, 37, 15.5, 17.5, 19 and 26.5 cm on Bas-385 leaves against isolates Xo-103, Xo-107, Xo-139, Xo-143, Xo-304, Xo-351 and MNR-4, respectively (Table 2). These lesion lengths were 44.7, 30.4, 72.6, 37.7, 43.6, 46.9 and 54.6% of total leaf lengths, respectively (Table 3). Bas-385 showed susceptibility to all isolates (Table 4). Isolates Xo-103, Xo-107, Xo-139, Xo-143, Xo-304, Xo-351 and MNR-4 gave lesions of 9.5, 22, 27, 26, 35.5, 7.5 and 21 constituting 24.1, 46.6, 47.1, 51.5 and 76.3% of leaf lengths on IR-6. IR-6 showed susceptibility against isolates except Xo-103 and Xo-351 to which it was moderately resistant. KSK-282 showed lesions of 19, 14.5, 12, 7.5, 18, 9 and 18.5 cm making 42.2, 35.3, 30.2, 17.2, 53.1, 23 and 45.8% of leaf lengths on inoculation with isolates Xo-103, Xo-107, Xo-139, Xo-143, Xo-304, Xo-351 and MNR-4, respectively (Tables 2 and 3). It showed only moderate resistance to isolates Xo-143 and Xo-351, whereas it was it was susceptible to all other isolates (Table 4).

Isolates used in the study gave lesions of different lengths on the same wild species which indicates that isolates were different from one another in their relative virulence capability. Gupta *et al*., (1986) tested pathogenicity of 13 isolates of *Xanthomonas campestris* pv. *oryzae* using 13 rice cultivars and lines and observed differential pathogenicity of different isolates. Noda *et al*., (1996) also observed variation in the pathogenicity of isolates of *Xanthomonas oryzae* pv. *oryzae* from 9 countries in South and East Asia. The three cultivated varieties of Pakistan used in this study were susceptible to all the isolates with few exceptions. This susceptibility of cultivated varieties to different isolates of bacterial blight is in line with findings of Akhtar *et al*., (2005) in which all the available rice germplasm of Pakistan was screened against bacterial blight and none of the cultivated varieties was found resistant. In other studies Khan *et al*., (2000a) and Khan *et al*., (2000b) screened varieties/lines including Bas-385, KSK-282 and IR-6 under field conditions but no entry was found with acceptable levels of resistance against BB. Chemma *et al*., (1998) also reported susceptible reactions of cultivated variety Bas-385 to bacterial blight under natural conditions. All these findings showed lack of resistance in locally available germplasm against bacterial blight.

Of all the wild relatives of rice investigated during the study, *O. nivara*, *O. longistaminata* and *O. grandiglumis* showed resistance to all the isolates. *O. nivara* didn't show any lesion against any isolate. It is worth mentioning that same wild rice species also displayed resistance against bacterial blight under natural conditions in 2006, whereas cultivated varieties and other wild rice species had differential levels of susceptibility to this disease grown under same conditions. The resistance of *O. nivara* and *O. longistaminata* to bacterial blight as observed in the present study is compatible with the findings of Kaur *et al*., (2005) and Khush *et al*., (1990). Though Kaur *et al*., (2005) reported for the first time the presence of resistant genes in *O. nivara* against bacterial blight, this study during the same year also revealed the presence of resistance in yet another accession of *O. nivara* against bacterial blight isolates of NWFP, Pakistan. Remaining wild species showed differential response to those isolates. These species were resistant to one or few isolates while at the same time showed susceptibility to the others which is in line with findings of Noda *et al*., (1996). They observed that resistance gene of rice variety DV 85 didn't operate to most isolates from other countries. In their study, variety Cas 209 displayed resistance to isolates of Philippines, but at the same time showed susceptible reactions to the isolates from other parts of the world. They also observed that Kinmaze, IR8 and IR24, the most susceptible cultivars, manifested high degree of resistance to the isolates from Myanmar. Resistance of wild relatives of rice to bacterial blight as observed in the present study is compatible with findings of Khush *et al*., (1990), Jena & Khush (1990), Amante *et al*., (1992), Multani *et al*., (1994) and Brar *et al*., (1996). In the reported studies wild relatives of rice displayed resistance against isolates of bacterial blight.

Conclusion

Bacterial blight has become a cosmopolitan menace to the rice crop. Identification of resistant sources and subsequent deployment of resistant genes in susceptible rice cultivars is the need of the hour. In the present study, *O. nivara*, *O. longistaminata* and *O. grandiglumis* manifested high levels of resistance against all the isolates. All of the isolates used in the study failed to produce any lesion on wild rice species, *O. nivara*. Resistant wild rice species particularly *O. nivara* observed in the present study seems to have resistant genes against all isolates. Correa & Zeigler (1995) suggested that selecting high levels of resistance when diverse sources are combined can be used to develop cultivars with stable resistance against diseases. Using this hypothesis, resistant wild species can be crossed with high yielding, widely adapted but susceptible to bacterial blight varieties, to incorporate resistance into otherwise improved varieties of rice.

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