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Resistance of hill rice genotpyes against *Xanthomonas oryzae* pv *oryzae* in mid-hills of Himachal Pradesh

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ABSTRACT

Study was conducted to identify hill rice genotypes showing resistance to the Rajiana isolate of bacterial blight in the mid-hills of Himachal Pradesh. In addition hill rice varieties and land races were also evaluated for resistance. The results showed that recessive genes xa 5, xa 8 and xa 13 and dominant gene Xa 21 imparted resistance to the prevailing isolate. Among different varieties of rice released in the state, seven viz. Himalaya 2, HPU 741, HPU 2216, HPU 957, HPR 1068, HPR 1156 and RP 2421 were found to be resistant. All the 14 traditional cultivars of HP, six hill rices from J&K and six japonica varieties tested were all found to be susceptible. Four out of 11 hill varieties from Almora viz. VL 25867-2-2, VL 30424, VL 30425 and VL 81 showed resistance to this isolate.

Key words: *rice genotype, bacterial blight, resistance, mid-hills, Himachal Pradesh*

Bacterial blight (BB) caused by *Xanthomonas oryzae* pv *oryzae* is one of the most destructive diseases of rice in almost all the rice producing countries including India (Mew 1988). The disease was first reported from India by Sreenivasan *et al*. (1959) and since then, it has caused many epidemics in different parts of the country. This disease was considered to be of minor importance in Himachal Pradesh and was confined only to the plains of the state adjoining Punjab and Haryana. For the first time in 1999 moderate incidence of BB was reported in isolated fields in Jasaour, Ronkhar and Serathana areas in the mid hills of Kangra district (Annonymous, 1999). The introduction of Sabarmati variety from Punjab was considered to a cause of reason for this incidence. Since then it has started appearing in moderate to severe form in the mid hills of Kangra and Mandi districts (Annonymous, 2004), the important rice producing regions of Himachal Pradesh.

Resistant varieties are helpful in the efficient management of this disease. However, development of resistant cultivars depends upon the availability and deployment of effective resistant genes for which a thorough analysis of virulence potential of causal organism is essential (Goel 1999). The present study was, therefore, undertaken to study the virulence potential of the prevailing isolate of the pathogen in the region and to identify genes/varieties showing resistance to this isolate.

Materials used in the present study comprised of 11 near isogenic lines (NILs) namely IR-BB 1, IR-BB 3, IR-BB 4, IR-BB 5, IR-BB 7, IR-BB 8, IR-BB 10, IR-BB 11, IR-BB 13, IR-BB 14 and IR-BB 21 in the background of IR 24 containing known genes for resistance to bacterial blight and 11 pyramid lines (IR-BB 50 to IR-BB 60) with 2 to 4 genes for resistance. Seeds of these NILs and Pyramid lines were received from IRRI, Philippines. In addition 12 improved varieties of rice recommended for cultivation in the mid hill conditions of Himachal Pradesh since 1971; 14 traditional cultivars of HP; 6 japonica varieties; 3 IRRI varieties, 11 hill varieties from Almora (Uttaranchal) and 6 from J&K were tested for their reaction to bacterial blight at CSKHPKV, Rice & Wheat Research Centre, Malan (950 m amsl).

One month old seedlings of each test entry were transplanted in two rows, each 3m long. For disease screening, five plants in each test entry were clip inoculated on 45 DAT with the bacterial suspension.

For preparation of inoculum, leaf segments collected from naturally infected plants of rice variety Sabarmati grown in village Rajiana of Nagrota Bagwan block in the Kangra district of Himachal Pradesh were agitated in 100 ml of sterilized distilled water for 30 minutes. The resulting suspension of bacterial ooze was used as inoculum. At least five leaves on each test plant were scored 21 days after inoculation on 0-9 scale following Standard Evaluation System for Rice (IRRI 1988).

During both the years, out of the 11 isogenic lines evaluated in this study, six namely IR-BB 1, IR-BB 3, IR-BB 7, IR-BB 10, IR-BB 11 and IR-BB 14 were found to be susceptible, whereas four lines namely IR-BB 5, IR-BB 8, IR-BB 13 and IR-BB 21 were resistant. Isogenic line IR-BB 4 showed moderately resistant reaction (Table 1). Thus the three recessive genes xa5, xa 8 and xa 13 and dominant gene Xa 21 showed resistance to the present isolate. All the pyramid lines showed highly resistant reaction to this isolate. Goel *et al*. (1998) also reported IR-BB 1, IR-BB 3, IR-BB 10, IR-BB 11 & IR-BB 14 to be susceptible to 8 strains of BB from Punjab. IR-BB 8 and IR-BB 13 which are resistant to Rajiana isolate of HP showed R to MR reaction to different isolates and Xa 21 which is showing resistance to HP isolate is susceptible to some races in Punjab. Higher effectiveness of pyramid lines against this pathogen has also been reported by earlier workers (Tu *et al*. 1998, Goel 1999).

Out of 12 improved varieties of rice released in HP from 1971 onwards seven namely, Himalaya 2, HPU 741, HPU 2216, RP 2421, HPU 957, HPR 1068 and HPR 1156 (Sukara Dhan 1) have been found to be resistant. Himalaya 1 was moderately resistant and newly released variety HPR 2143 and Fukunishiki, a japonica variety being used as a source of resistance to blast by the Biotechnology Centre of the University has been found to be susceptible to BB isolate (Table 1). The three aromatic/basmati lines viz. T23, Hassan Serai and Kasturi were also found to be susceptible (Table 1). Since, the disease has started appearing regularly in some parts of Himachal Pradesh, growing of susceptible varieties should be avoided in the disease prone areas. All the 14 traditional cultivars of HP (Table 1), 6 japonica varieties and 6 hill rice varieties from J & K viz., SKAU 23, SKAU 27, SKAU 105, SKAU 356, SKAU 357 and SKAU 383 were found to be susceptible to the isolate (Table 1). Out of 11 hill rice varieties from Almora, VL 30424, VL 30425 and VL 81 were found to be resistant (Table 1). VL 25867-2-2 being used as blast resistant donor in hill rice breeding programme and three IRRI varieties IR 36, IR 64 and IR 72 were found to be resistant to BB isolate.

Table1. Reaction of different rice genotypes, IR-BB isogenic and pyramid lines, recommended rice varieties & Traditional cultivars of HP to Rajiana isolate of *Xanthomonas oryzae* pv oryzae

Genotype	Disease score (0-9 scale)		Genotype	Disease score (0-9 scale)	
Isogenic lines	2006	2007	Pyramid lines	2006	2007
IR-BB 1	9	9	IRBB 50	1	1
IR-BB 3	9	9	IRBB 51	1	1
IR-BB 4	5	5	IRBB 52	1	1
IR-BB 5	1	3	IRBB 53	1	1
IR-BB 7	7	9	IRBB 54	1	1
IR-BB 8	1	3	IRBB 55	1	1
IR-BB 10	9	7	IRBB 56	1	1
IR-BB 11	9	7	IRBB 57	1	1
IR-BB 13	1	3	IRBB 58	1	1
IR-BB 14	9	9	IRBB 59	1	1
IR-BB 21	1	1	IRBB 60	1	1
Released varieties			Traditional Cultivars		
Himalaya 1	5	3	China 988	9	9
Himalaya 2	3	3	Ram Jawain 100	9	9
HPU 741	3	1	R 575	9	9
HPU 2216	3	1	Achhoo	9	9
RP 2421	3	1	Kalizhini	7	5
HPU 957	3	3	AC 19146	9	9
HPR 1156	3	1	AC 19164	9	9
HPR 2143	9	9	AC 19178	9	9
HPR 1068	3	1	AC 19180	9	9
PLP Purple	7	7	AC 19186	9	9
			AC 19197	9	9
T 23	7	7	AC 19229	9	7
Kasturi	7	9	AC 19243	9	9
Hassan Serai	9	7	AC 19283	9	9
Koshihikari	9	7	VL 25867-2-2	3	3
Hinohikari	9	7	VL Dhan 61	9	7
Naggar Dhan	7	7	VL 81	3	3
Norin 18	7	7	Vivek Dhan 82	7	5
Bhrigu Dhan	9	9	VL 93-2767	7	7
Fukunishiki	7	7	VL Dhan 85	7	3
Jammu & Kashmir			VL Dhan 207	9	9
			VL 3400	7	7
SKAU 23	7	9	VL 4561	7	7
SKAU 27	9	9	VL 30424	3	1
SKAU 105	7	9	VL 30425	3	1
SKAU 356	7	9	IRRI Varieties		
SKAU 357	9	9	IR 36	1	1
SKAU 383	9	9	IR 64	1	1
			IR 72	3	1

Till recent times, rice blast (*Magnoporthe grisea*) was the major problem of rice cultivation in the hills and breeding for bacterial leaf blight was not a priority which is the main reason that majority of varieties from HP, Almora and J&K are susceptible to this disease. Occurrence of BB at altitudes around 1000m in mid hills has now started posing major threat to rice cultivation in the rice bowl of HP. The GIS Centre of the HP Krishi Vishvavidyalaya, Palampur has reported an increase in temperature from 0.4 to 2.4 ^{0}C and decrease in rainfall from 15 to 40% in the State over the last two decades, which has shortened the reproductive phase of rice crop by about 2 to 10 days. Whether the spread of disease in mid hills can be attributed to this climate change or the appearance of a new more virulent race needs to be ascertained.

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