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Short Communication

Distribution of BCMV strains in Kashmir valley and identification of resistant sources of *Phaseolus vulgaris*

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Abstract

Extensive survey of 100 commercial bean growing areas of Kashmir was conducted during *kharif* 2009 and 2010 indicated only 13 locations to be free from Bean Common Mosaic Virus (BCMV) disease. The disease incidence ranged from 0.50 to 85%. The maximum disease incidence was recorded in Srinagar followed by districts Anantnag and Bandipora, respectively. Confirmation of the association of BCMV with each isolate was made by mechanical transmission, DAC-ELISA and RT-PCR. Evaluation of eighty-five accessions of common bean of diverse origin under controlled glass-house conditions identified R-40, R-155, R-3, B-6, Pencil white, SKAU-B-02, SKAU-B-01, Pointed lady, TO, P1207262, TU, KRC-5, R-14, Jubila, Contender and Monroe accessions to be resistance against all the five strains (NL-1, NL-1n, NL-7, NL-7n and NL-4) of BCMV prevalent in Kashmir.

Key words: BCMV, common bean, strains, resistance

Common bean (*Phaseolus vulgaris* L.) is the premier grain legume crop in North-Western Himalayan states of India including Jammu & Kashmir with wide variation in its gene pool (Pathania et al. 2006). It is infected by numerous viruses mostly transmitted by aphids and whiteflies (Colinet et al. 1994; Hall 1991). However, Bean common mosaic virus (BCMV) and closely related Bean common mosaic necrosis virus (BCMNV) are seed transmitted and widely distributed throughout the world (Sharma et al. 1999; Mavric and Vozlic 2004). The virus has been reported to cause severe crop losses in various parts of the world (Morales 1998; Spence and Walkey 1995; Flores et al. 2003). In India, the occurrence of BCMV was recorded for the first time simultaneously by Yaraguntaiah and Nariani (1963) and Nagaich and Vashisht (1963). In Himachal Pradesh and Kashmir valley (India), evaluations of virus isolates revealed presence of BCMV (Sharma et al. 2008; Hamid et al. 2013). The phenotypic recombination of BCMV and BCMNV strains indicates the likely appearance of more complex disease problems caused by these viruses in future (Silbernagel et al. 2001). The high rate of seed transmission of these viruses and their management through physical and chemical means is difficult (Galvez and Morales., 1989). Drijfhout (1978) demonstrated involvement of four recessive (*bc-1, bc-2, bc-3* and *bc-u*) and a dominant gene *I*. However, expression of various *R*-genes and their combinations is effective only in the presence of the non-specific recessive gene *bc-u,* except *bc-3* and *I*. BCMV and BCMNV resistance breeding programmes are primarily oriented to the development of multiple gene resistance to these viruses (Drijfhout 1978; Kelly 1997). In India work on resistance to BCMV strains and its inheritance in some Indian land races of common bean has been studied in Himachal Pardesh (Sharma et al. 2008). The objective of the present study was to examine the incidence, distribution of BCMV strains and to identify sources of resistance against the five strains of BCMV present in Kashmir Valley.

The diseased bean plant samples were collected from different bean growing areas in ten districts of Kashmir valley, during June to August, 2012 and the disease incidence recorded as per symptoms. To

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confirm the BCMV in the collected samples, DAS ELISA and RT-PCR techniques were employed according to (Sharma et al. 2008). Hamid et al. (2013) identified 5 strains (NL-1, NL-4, NL7, NL1n and NL7n) in the Kashmir valley using international differential set among the 100 samples collected during the survey. These strains were also used in screening according to their respective geographical area.

Eighty-five common bean accessions comprising landraces, cultivars and exotic genotypes procured from CIAT Columbia, NBPGR, New Delhi, HPKV Palampur and SKAUST-K were screened under insect-proof glasshouse conditions at 24-32^{o}C by Sap inoculation. For screening, six plants of each genotype were assayed with the inoculum of one strain using the leaf-rub method and three plant were kept as control (Sharma et al. 2008). Each virus strain was tested twice. Proper precautions were taken to avoid the contamination of virus strains during these studies. Test plants were kept under observation until the appearances of disease symptoms. Plants showing resistant reactions were re-inoculated onto healthy seedlings of susceptible cultivar SR1 to detect symptomless carriers. Besides symptomless plants were tested using DAS-ELISA for presence of virus. Plants showing mosaic, leaf rolling, green vein banding and blistering symptoms were graded susceptible, whereas the symptomless plants were rated as resistant (Bos, 1971).

Extensive survey of commercial common bean growing areas of Kashmir valley revealed the prevalence of the disease in almost all bean growing areas of the valley with an incidence ranging form 0.50 to 85.00%, maximum incidence being in Shalimar area of district Srinagar. Out of 100 locations surveyed in district Anantnag, Baramulla, Badgam, Bandipora, Ganderbal, Kulgam, Kupwara, Pulwama, Shopian and Srinagar, disease was recorded in 87 locations, whereas 13 locations were free from the disease. Range and mean per cent disease incidence in districts surveyed is given in Table 1. Pole type cultivars of bean grown as intercrop with maize or apple recorded less disease incidence in comparison to dwarf type cultivated in monoculture except in some areas of Anantnag (54%) followed by Shopian (34.40%). Average disease incidence in pole type cultivar grown as intercrop was also highest (15.60%) in district Anantnag (Table 1).

Variable incidence of the disease in different areas has been earlier recorded (Sharma and Dhar 1994; Sharma et al. 1999; Kapil et al. 2011).

Table 1. Per cent disease incidence of BCMV on different cropping pattern and plant type in different districts of Kashmir (India)

District	Disease incidence (%)					
	Cropping pattern		Plant type		Range	Mean
	Mono	Mixed type	Bush type	Pole		
Kupwara	4.60	3.00	5.30	2.80	0.50-10.0	2.87
Baramulla	15.40	2.70	18.70	4.70	0.50-27.0	10.35
Srinagar	25.50	-	36.00	0.80	0.0-85.0	25.55
Badgam	7.80	0.30	8.20	3.00	0.0-15.0	4.00
Anantnag	54.00	15.60	54.00	15.60	0.50-81.0	23.35
Kulgam	31.60	1.50	36.70	3.00	0.0-65.0	16.55
Bandipora	29.50	4.60	45.30	12.10	2.00-57.0	22.10
Ganderbal	26.50	2.80	31.50	4.50	0.0-39.0	9.95
Pulwama	15.00	1.30	16.60	2.60	0.0-32.0	9.60
Shopian	34.40	10.00	36.20	12.80	0.50-50.0	22.20
Mean	24.40	4.10	28.80	6.19		

Cropping pattern as well as crop type significantly influences the extent of the disease development. The increased incidence in solo crop than in mixed crop with maize recorded in the present study can be explained on the basis of development of predisposing factors. The increased relative humidity and close contact between adjacent plant parts in sole/ mono-crop types than in mixed cropping with maize where the conditions for insect vector proliferation such as relative humidity and contact with adjacent plant parts are not met. The higher disease incidence in bush type compared to pole type crop recorded is again owing to similar factors. Similar reasons for varied incidence on account of varied cropping pattern and crop type have also been suggested by Kapil et al. (2011). The uneven topography and diverse agro climatic conditions prevalent in the state along with cultivation of diverse genotype, use of disease free bean seeds of improved cultivars and adoptions of pest control measures also account for differences in disease incidence between different locations. Flores et al. (2003) studied the occurrence and diversity of BCMV and BCMNV in Mexico and reported that sowing of traditional seed obtained from the previous harvest, regional seed exchange and imports from other countries had an impact on the distribution and diversity of both the viruses.

Out of a total of five strains namely, NL-1, NL-1n, NL-7, NL-7n and NL-4 (Hamid et al. 2013), two strain groups *viz*., NL-4 and NL-7 were prevalent in district Kupwara, whereas in district Baramulla NL-1n and NL-7n are present. In district Bandipora and Ganderbal, only one strain NL-1 was present; NL-1 and NL-1n were prevalent district Srinagar, whereas in district Badgam and Shopian two strains NL-1 and NL-7 were present. In district Pulwama BCMV strains NL-4 and NL-7n were present, whereas in district Kulgam NL-7 and NL-7n strain were prevalent. In district Anantnag, only NL-4 strain was observed.

Eighty-five accessions were evaluated under controlled glass house conditions against all the five strains (NL-1, NL-1n, NL-7, NL-7n and NL-4) of BCMV prevalent in Kashmir. The study showed that only 17 genotypes were resistant to the test virus strains. Strain specific resistance was noticed in 30 genotypes, *viz*., B-14, B-73, Red Lands Green Leaf C against NL-1 and NL-1n, Michelite '62', Red Lands Green Leaf B against NL-1, NL-1n, NL-7 and NL-7n, R-38, R-166, R-97, R-67, B-5, B-3, B-2, B-16, B-13, B-12, B-66, B-25, B-15, B-21, KRC-8, L-Line, SKAU-B-04, SKAU-B-03 and SKAU-B-05 against NL-4 and R-33, R-38, R-2 and R-34 against NL-1, NL-1n and NL-4. Among various cultivars, only Jubila showed local necrotic lesions followed by veinal necrosis after four days of inoculation at temperatures above 32°C. The comparative resistance of common bean to different strains of BCMV are shown in Table 2. Resistance in common bean germplasm has also been reported from India by different workers. Gupta and Chowfla (1990) after evaluating 68 indigenous cultivars of common bean against BCMV found only 11 resistant to the disease. Similarly, out of the 48 genotypes screened against BCMV, 36 were found free from the disease by Sharma and Dhar (1994). The differential response of the host genotypes to different BCMV strain groups observed during the present investigation is perhaps the first report of this kind in Jammu and Kashmir. Systematic studies on resistance breeding have been undertaken elsewhere outside India. The resistance in beans is governed by non-specific dominant gene *I*, five strain specific recessive genes *viz*., *bc-1, bc- 1^2, bc-2, bc-2^2* and *bc-3* and one strain non-specific gene *bc-u* (Drijfhout, 1978). A gene for gene relationship has been established between strain specific resistance genes *bc-1, bc-1^2, bc-2 bc-2^2* and virus pathogenicity genes. Since new pathotypes of BCMV are known to occur in bean growing areas after the introduction of cultivars having resistance controlled only by combinations of the strain- specific recessive resistance genes, breeders all over the world working on bean improvement program are now incorporating the strain non-specific dominant *I* gene along with various recessive genes to reduce the potential development of new pathotypes (Kelly et al. 1995, 1997; Morales 1998; Silbernagel et al. 2001; Mukeshimana et al. 2005). Resistant sources identified in the present investigation could easily be exploited to breed BCMV resistant cultivars against all prevalent strains of the virus. Moreover the resistance specificity present in these cultivars needs to be dissected either employing the tightly linked markers for various BCMV resistance genes or by using the genetic studies.

Table 2. Comparative resistances in common bean to different BCMV strain groups prevalent in Kashmir (India)

Pathogroup (strains)	Resistant source(s)
PG I (NL1, NL1n)	R-33, R-38, R-45, B-14, B-73, R-2, R-34, Red Lands green leaf B, Michelite '62'
PG II (NL7, NL7n)	Red Lands green leaf B, Michelite '62'
PG VII (NL4)	R-33, R-38, R-67, B-5, B-3, B-2, B-16, B-13, B-12, B-66, B-25, B-15, B-21, SKAU-B-04, SKAU-B-03, SKAU-B-05, G2333, Baspa, R-2, R-34
Common sources Pencil(PGI, PG II, PGVII)	R-40, R-155, R-3, B-6, white, SKAU-B-02, SKAU-B-01, Pointed lady, TO, P1207262, TU, KRC-5, R-14, Jubila, Contender, Monroe

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