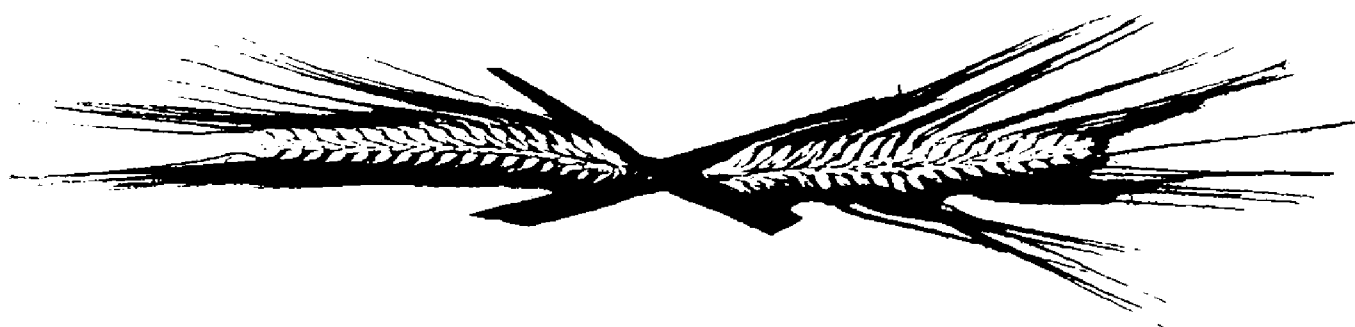


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Reaction of barley accessions to BaYMV and BaMMV in Japan, compared with data in Germany

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Barley yellow mosaic virus (BaYMV) causes a serious damage to barley production, sometimes by mixed infection with barley mild mosaic virus (BaMMV). Both viruses are transmitted by a soil-inhabiting fungus, *Polymyxa graminis* Led. Recently, some of the BaYMV-resistant cultivars changed to susceptible due to the appearance of new strains of the virus: the resistant "*rym4* cultivars" were infected with the strain BaYMV-2 in Europe (Huth 1989) and the "*rym5* cultivars" were damaged by the strain BaYMV-III in Japan (Kashiwazaki et al. 1989). To find new resistance genes to BaYMV and BaMMV, extensive surveys have been conducted in Europe and East Asia including Japan, Korea and China. However, reactions of barley varieties obtained from different districts are too complex to compare directly, since the viruses are differentiated into several strains exhibiting different reactions to barley genotypes.

When the junior author was supported by the postdoctoral fellowship of the Japan Society for the Promotion of Science (JSPS) to study at Kyushu University in 1990, the present investigation was carried out in Japan. Using the same barley accessions that were examined in reactions to German BaYMV and BaMMV strains, we observed their reactions in the fields infested with BaYMV-I in Fukuoka and with BaMMV-Na in Yamaguchi, respectively. The results to BaYMV-I and BaMMV-Na in Japan (JPN) were compared with those to BaYMV-1 and BaYMV-2, and BaMMV obtained in Germany (DEU) (Friedt et al. 1985, Huth 1991, Ordon et al. 1993, Götzt and Friedt 1993, and Ordon 1999).

As shown in Table 1, all the accessions were resistant to Japanese BaYMV-I except Turkey 235 which was susceptible to three strains of BaYMV. The remaining accessions were classified into three groups based on their resistance spectrum to the strains of BaYMV: (1) Most of the accessions were resistant to the three strains of BaYMV. (2) Some of the accessions were resistant to Japanese BaYMV-I, but susceptible to German BaYMV-1 and BaYMV-2. To this group belong Anson Barley, Bulgarian 347, Corona, Gerbel, Krasnodar 1920 and Maksimirski 452. (3) The accessions resistant to BaYMV-1 but susceptible to BaYMV-2 in Germany were resistant to Japanese BaYMV-I. Most of them carry the resistance gene *rym4*, such as Asorbia, Banjo, Diana, Franka, Ogra and Sonate. These results indicate that resistant accessions to Japanese BaYMV-I were not always resistant to German strains of BaYMV, and that the German BaYMV strains were more virulent than Japanese BaYMV-I.

Reactions of barley accessions to Japanese BaMMV-Na were almost similar to those to German BaMMV. However, some deviating reactions were found. Some accessions were resistant to the German strain but susceptible to the Japanese one, such as Asahi 9, Hayakiso, Misato Golden and others. The reverse reaction was detected in two accessions, Corona and Gerbel. The difference in the pathogenic spectrum of the virus indicates that BaMMV is clearly differentiated in Japan and Germany.

The comparison of reactions to BaYMV and BaMMV as virus groups showed that Turkey 235 was susceptible to all strains of BaYMV, but resistant to the Japanese and German BaMMV strains. On the contrary, Japanese accessions, Ea 52 and Ishuku Shirazu carrying the resistance

gene *rym3* to BaYMV, were susceptible to the both strains of BaMMV in Japan and Germany. Furthermore, Misato Golden possessing the resistance gene *rym5* was susceptible to BaMMV-Na in Japan, although it was resistant to German BaMMV, BaYMV-1 and BaYMV-2 as well as to Japanese BaYMV-I. Recently, the same reaction was found in Asaka Gold, a further *rym5* resistant cultivar, which was susceptible to Japanese BaMMV-Na (unpublished). These results strongly indicate the resistance genes to BaYMV (*rym3* and *rym5*) are not pleiotropically effective in resistance to either or both BaMMV strains.

From the comparison between the Japanese and German strains of BaYMV and BaMMV, the following conclusions are proposed: (1) Resistance genes to BaMMV are different from those to BaYMV, so the different gene symbols should be used as *rym* to BaYMV and *rmm* to BaMMV. (2) Resistance genes are not always effective to all strains of either BaMMV or BaYMV, thus the designation of resistance genes should be expressed with its resistance spectrum to strain(s) of the virus. (3) Comparative investigations should be conducted in different countries and at various locations using the barley core collection. (4) Finally, information about resistance to the viruses and virus strains should be published in a suitable journal or internet as quick as possible.

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Table 1. Reaction of barley accessions to Japanese (JPN) and German (DEU) strains of BaYMV and BaMMV.

Accession	Okayama Univ. No.	BaYMV-1 (JPN)	BaYMV-1 (DEU)	BaYMV-2 (DEU)	BaMMV (JPN)	BaMMV (DEU)
# 9048	OOU343	R	R		R	R
# 10247	OOU022	R	R	Suscept	R	R
43-Gamma 18		R			R	R
Andrea		R			R	R
Anson Barley		R	Suscept	Suscept	R	R
Asorbia (<i>rym4</i>)		R	R	Suscept	R	R
Asahi 9		R			Suscept	R
Athene (<i>rym4</i>)		R			R	
Banjo (<i>rym4</i>)		R	R	Suscept	R	R
Barbo		R			R	
Birgit		R			R	R
BR421c12		R			R	
Breunstedts Schladener		R			R	
Brunhild		R	R	Suscept	R	R
Bulgarian 347	OOU615	R	Suscept	Suscept	R	R
Changchou 2	OUC345	R	R	R	R	R
Chikurin Ibaraki 1		MR	R	R	R	R
Corona		R	Suscept	Suscept	R	Suscept
Dea		R			R	R
Diana (<i>rym4</i>)	OOU774	R	R	Suscept	R	R
Dura		R			R	
Ea 52 (<i>rym3</i>)	OOU555	R	R	R	Suscept	Suscept
Esfahan 3	OUI633	MR	R	R	R	R
France 7	OOU626	R	R	R	R	R
Frances		R	R	Suscept	R	R
Franka (<i>rym4</i>)	OOU474	R	R	Suscept	R	R
Gaulois		R			R	R
Gerbel		R	Suscept	Suscept	R	Suscept
Gloria		R			R	R
Hakei I-41		R	R	R	R	R
Hayakiso		R	R	R	Suscept	R
HB 79064		R			Suscept	
HB 81035		R	R	R	Suscept	R
Hiproly		R			Suscept	
Hsingwuke 2	OUC630	R	R	R	R	R
Ishuku Shirazu (<i>rym3</i>)	OOU546	R	R	R	Suscept	Suscept
Iwate Mensury 2	OOU308	R	R	R	MR	R
Iwate Omugi 1	OOU608	R	R	Suscept	R	R
Japan S-1001		R	R	R	MR	R
Kagoshima Kobai 1	OOU692	R	R	R	R	R
Kairyō Hadaka 2	OOU687	R			Suscept	R
Kanto Nijo 19		R	R	R	Suscept	R
Kobinkatagi	OOU671	R	R	R	MR	R
Krasnodar 1920	OOU320	R	Suscept	Suscept	R	R
Maksimirski 452	OOU321	R	Suscept	Suscept	R	R
Mangyeong Naked 3	OOU625	R	R	R	R	R

Table 1 (continued)						
Accession	Okayama Univ. No.	BaYMV-1 (JPN)	BaYMV-1 (DEU)	BaYMV-2 (DEU)	BaMMV (JPN)	BaMMV (DEU)
Mihori Hadaka 3 (<i>Ym2</i>)	OIJ373	R	R	R	R	R
Misato Golden (<i>rym5</i>)	OIJ848	R	R	R	Suscept	R
Miyako A	OIJ610	R	R	R	R	R
Mokusekko 3 (<i>rym1+rym5</i>)	OUC627	R	R	R	R	R
Muju Covered 2	OJK629	R	R	R	R	R
N. 14		R			R	R
Namji Milyandg Native	OJK647	R	R	R	R	R
Nirakei 31		R			Suscept	R
Nirakei 55		R	R	Suscept	MR	R
Nittakei 1		R			Suscept	R
Nixe		R			R	R
Ogra (<i>rym4</i>)		R	R	Suscept	R	R
Ou 1	OIJ613	R	R	R	MR	R
Paisha Tayeh 1	OUC630	R	R	R	R	R
Palomino		R			R	R
Pohang Covered 3	OJK660	R	R	R	R	R
Rokkaku 1	OIJ624	R	R	R	R	R
Ragusa (<i>rym4</i>)		R			R	R
Romanze		R	R	Suscept	R	R
Russia 32	OOU671	R	R	Suscept	R	R
Russia 57	OOU679	R	R	R	MR	R
Senbon Hadaka	OIJ246	R			Suscept	R
Shahr-kord 1	OUI634	R			R	R
Sonate (<i>rym4</i>)	OOU175	R	R	Suscept	R	R
Taihoku A	OIJ697	MR	R	R	R	R
Turkey 235	OUT079	Suscept	Suscept	Suscept	R	R
Turkey 713	OUT837	R	R	R	MR	R
Turkey Naked 2		R	R	R	R	R
Yane Hadaka 44	OIJ645	R	R	R	R	R
Yukishirazu C	OIJ611	R	R	Suscept	R	R
Venus		R			R	R
Wigo		R			R	R
Zairai Rokkaku	OIJ619	R	R	R	R	R

Okayama Univ. No.: Okayama University Barley Accession Number.

OIJ: Japan. OUK: Korea. OUC: China. OUI: India and Southwest Asia.

OUT: Turkey. OOU: Europe.

Data from Germany (DEU) are referred to Friedt et al. (1985), Huth (1991), Ordon et al. (1993), Götz and Friedt (1993) and Ordon (1999).

R: Resistant. MR: Moderately resistant.

(): Resistance gene to BaYMV or BaMMV.