Neth. J. Pl. Path. 83 (1977) 13–25

The identification of two new strains of bean common mosaic virus

E. DRIJFHOUT[1] and L. BOS[2]

[1] Institute for Horticultural Plant Breeding (IVT), Wageningen
[2] Institute of Phytopathological Research (IPO), Wageningen

Accepted 13 September 1976

Abstract

Two sap-transmissible virus isolates from bean (*Phaseolus vulgaris* L.) were identified as bean common mosaic virus (BCMV) on the basis of particle size and morphology, serology, non-persistent aphid transmission, very limited host range, and symptoms and seed transmission in bean.

In bean varietal reaction both isolates differed from each other and all six Dutch BCMV strains described before. From literature data it may be concluded that they also differ from thirteen other strains described elsewhere. The isolate from Peruvian seed may be related to strains reported from Costa Rica and Peru, but these have been described incompletely.

The two isolates obtained at Wageningen are therefore described as new strains and designated BCMV-NL7 and BCMV-NL8. The latter seems unusual in its extremely high dilution end point, in its serological affinity to both BCMV and BYMV, and in not being infectious to *Chenopodium amaranticolor* and *C. quinoa*.

Tetragonia expansa proved to be a new local lesion host of BCMV. There is an urgent need for international standardization of strains of BCMV.

Introduction

Bean common mosaic virus (BCMV) is a sap- and seed-transmitted virus that is aphid-borne in the non-persistent manner and seems to occur in all countries where bean (*Phaseolus vulgaris* L.) is grown. Depending on host cultivar, virus strain and environmental conditions, systemic infection may lead to common mosaic or to black-root disease (systemic necrosis) (Bos, 1971a).

Various strains have been described on the basis of bean varietal reactions, notably in countries where bean for a long time has been bred for resistance, e.g. in the USA and the Netherlands. New strains were usually discovered in newly bred cultivars, resistant to earlier described strains of the virus. Detailed studies are now being made on the genetics of the host-virus relationships (DRIJFHOUT, 1977), and on the classification of strains described so far (DRIJFHOUT and SILBERNAGEL, 1977). In the course of this work two new strains were detected, that will now be described. For a detailed literature survey see DRIJFHOUT (1977). The new strains have been directly compared with all strains reported earlier in the Netherlands and the results were compared with literature data on foreign strains. The latter comparisons were later experimentally confirmed by DRIJFHOUT and SILBERNAGEL (1977).

Materials and methods

The new strains were tentatively designated B53 and B54. B53 was isolated in 1974 at Wageningen from seedlings of an unknown Peruvian bean cultivar, grown in a greenhouse from seed originally collected near Huallapampa, Peru. B54 was isolated in 1974 from a progeny obtained from a cross of 'Imuna' × 'Red Mexican U.I. 34' in a private breeder's field.

For convenience, the strains earlier described in the Netherlands were given NL numbers in their order of description, viz. NL1: Westlandia strain (Van der Want, 1954); NL2, NL3, NL4: Imuna, Michelite, and Great Northern strains, respectively (Hubbeling, 1963); and NL5 and NL6: Jolanda and Colana strains (Hubbeling, 1972).

All Dutch strains, originating from the Institute of Phytopathological Research (IPO), were maintained at the Institute for Horticultural Plant Breeding (IVT) in bean plants and also in seeds, the latter as a reserve in case of contamination.

To identify the isolates B53 and B54 as strains of BCMV, experimental host ranges (Table 1) and some other properties were studied in an insect-proof virus greenhouse. In some of the tests, strain NL1 was included for comparison. To demonstrate the presence of virus, back inoculations were made onto plants of 'Bataaf' for B53,

Table 1. Summary of host range tests.

Plant species	Virus isolate		
	B53	B54	NL1
Legumes			
Phaseolus vulgaris 'Bataaf'	L S[1] 14/14[2]	L –* 15/15	L S 15/15
'Dubbele Witte'	L S 15/15	L S 15/15	L S 15/15
'Michelite'	L – 15/15	L S 15/15	L – 15/15
'Monroe'	L – 15/15	L – 15/15	L – 15/15
Pisum sativum 'Koroza'	– – 0/16	– – 0/16	– –* 0/8
'Rondo'	– – 0/6	– – 0/8	– –* 0/8
Vicia faba 'Compacta'	l s 0/14	l – 0/16	– –* 0/8
Non-Legumes			
Chenopodium amaranticolor	L – 9/9	– – 0/6	L – 4/4
Chenopodium quinoa	L – 9/9	– – 0/6	l – 0/4
Cucumis sativus	– – 0/4	– – 0/4	
Gomphrena globosa	l – 0/6	l – 0/6	– –* 0/4
Nicotiana clevelandii	l s 0/6	l s 0/6	l s 0/6
Nicotiana glutinosa	– – 0/2	– – 0/2	
Nicotiana tabacum 'White Burley'	– – 0/2	– – 0/2	
Tetragonia expansa	L(s)	L –	L –*

[1] L = Local symptoms; S = Systemic symptoms; l = Latent local infection; s = Latent systemic infection; – = No infection as demonstrated by back inoculation onto *Phaseolus* beans ('Bataaf' for B53, 'Michelite' for B54, 'Dubbele Witte' for NL1); –* = Absence of symptoms but no back inoculation made.

[2] Number of plants showing symptoms over number of plants inoculated.

Tabel 1. Samenvatting van de waardplantproeven.

'Michelite' for B54 and 'Dubbele Witte' for NL1, observed for symptom development during five weeks. Persistence of infectivity in expressed sap was determined according to Bos et al. (1960) and tested on the above mentioned indicator cultivars, sometimes including 'Monroe' for B54.

For the bean varietal tests all strains were propagated in 'Dubbele Witte' and to check strain purity simultaneously inoculated onto four plants of each of the differentials 'Imuna', 'Redlands Greenleaf B', 'Michelite', 'Great Northern U.I. 31' and 'Widusa' of Table 5. Inoculum was always prepared from leaves of 'Dubbele Witte' with clear symptoms 3–5 weeks after inoculation.

The series of differential bean cultivars (listed in Table 5) was as devised by Drijfhout and Silbernagel (1977). Host cultivars were from seed stocks at IVT. Dr M. J. Silbernagel, Prosser, Wash. USA, provided seeds of 'Great Northern U.I. 31', 'Improved Tendergreen 40031', 'Michelite 62', 'Puregold Wax', 'Red Mexican U.I. 35', 'Sanilac' and 'Stringless Green Refugee'. Miss Barbara Ballantine, Rydalmere, NSW, Australia, supplied 'Redlands Greenleaf B'.

Young bean seedlings transplanted into 12 cm pots, one plant per pot, and grown in a glasshouse at 20–26°C, were inoculated 9–10 days after sowing when the first trifoliate leaf started to develop. Carborundum (500 mesh) served as an abrasive and the primary leaves were rubbed with a small piece of foam plastic dipped in inoculum, diluted 1 : 10 with tap water. Reactions were recorded 1, 2, 3 and 4 weeks after inoculation. Plants were grown and kept in a greenhouse at 20–26°C.

In case of absence of systemic symptoms or of doubtful systemic reaction in the bean cultivars of groups 1–5 of Table 5, that never reacted with systemic necrosis, the plants were indexed for virus 3 weeks after inoculation by back inoculation onto 'Dubbele Witte'. For this a mixed sample of leaflets from the third trifoliate leaf of four plants was deepfrozen and after thawing hand-squeezed to press some virus containing sap on the carborundum-dusted primary leaves of four plants of 'Dubbele Witte'.

To prevent contamination, the bean varietal tests were performed under strict hygiene (aphid control, use of plastic screens to prevent contact between blocks with different strains, and careful disinfection of hands and tools).

For serology, the micro-precipitin test was used. The tests were performed by Mr. D. Z. Maat, serologist of the IPO. Further technical details are given in Table 3.

Most details of insect-transmission tests, employing two aphid species, are given in Table 4. After starvation for 2 h, the aphids were first fed for 10 min on infected leaves, thereafter for $^1/_2$ h on the first series of test plants (first transfer) and then overnight on the second series (second transfer).

Results

Host range and symptoms. The results of host range tests are summarized in Table 1.

Phaseolus vulgaris 'Bataaf', regularly used at IPO as a test plant for several viruses, reacted to all three isolates with vague chlorotic local lesions and some brown etching, especially with B53. The lesions appeared much earlier with B53 and B54 than with NL1. With B54 no obvious systemic symptoms were procuced. B53 and NL1 caused a vague mottling, curling and plant stunting, more striking with B53 and slight with NL1.

In 'Dubbele Witte' B53 caused vague chlorotic local lesions. They turned into necrotic flecks of varying size, later also appearing with B54 and NL1. All isolates produced typical leaf narrowing

Fig. 1. Systemic symptoms of isolate B54 in 'Michelite'.

Fig. 1. Systemische symptomen van isolaat B54 in 'Michelite'.

and rolling. B53, and to a lesser extent NL1, in addition showed some dark green areas near the bigger veins.

'Michelite' reacted to all isolates with many vague chlorotic local lesions. With B54 they appeared earliest (in ca 5 days), soon turned necrotic and extended into the veins, and were followed by shriveling and casting of the inoculated primary leaves. With B53 and NL1 the local lesions were distinct green and brown rings when the primary leaves turned yellow. With B54 development of trifoliate leaves was greatly retarded and they later remained very small, mottled and curled. After some recovery later outgrowth showed leafroll and mosaic characteristic of BCMV (Fig. 1).

In 'Monroe' B53 and NL1 produced almost identical brown necrotic local rings or solid flecks with necrosis extending along the veins (Fig. 2 A, C). The pattern was especially striking when the leaves turned yellow. With B54 local lesions first were chlorotic but soon surrounded with a green, later brown edge, also extending along the veins (Fig. 2B).

Chenopodium amaranticolor reacted with local lesions to B53 and NL1 only. They sometimes started 8 days after inoculation and then were small and chlorotic. Often local lesions only showed up after 20 or more days as conspicuous rings in yellowing leaves. (Fig. 3, right). With B 54 no symptoms

Fig. 2. Local symptoms in primary leaves of 'Monroe' thirteen days after inoculation with (A) B53, (B) B54, and (C) NL1.

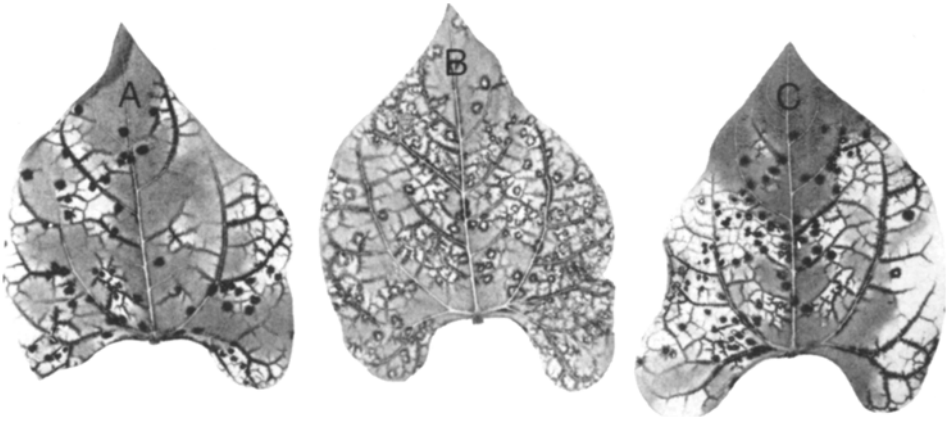

Fig. 2. Lokale symptomen in primaire bladeren van 'Monroe', dertien dagen na inoculatie met (A) B53, (B) B54 en (C) NL1.

Fig. 3. Local reaction of *Chenopodium amaranticolor* (right) and *C. quinoa* (left) to inoculation with isolate B53.

Fig. 3. Lokale reaktie van Chenopodium amaranticolor (rechts) en C. quinoa (links) op inoculatie met isolaat B53.

could be observed, neither could virus be recovered. In *C. quinoa* with B53 usually only many faint chlorotic local lesions were produced, later appearing as green rings in yellowing leaves (Fig. 3, left). Sometimes these were the only observed symptoms showing up 16–20 days after inoculation. With B54 no symptoms were procuced, neither could virus be recovered. NL1 only produced a local latent infection.

In *Tetragonia expansa* all three isolates caused a few identical faint chlorotic local lesions, sometimes apearing later as large green rings when inoculated leaves turned yellow.

Persistence of infectivity in expressed sap. Results are summarized in Table 2. The 'Michelite' plants that became infected with B54 always showed highly characteristic symptoms even at the highest dilution.

Table 2. Summary of infectivity determinations in expressed sap.

Characters	Virus isolate	
	B53	B54
Dilution end-point	10^{-4}–10^{-5}	A.[1] 10^{-6}–10^{-7} B.[1] 10^{-7}–10^{-8} C.[1] 10^{-8}–10^{-9}
Thermal inactivation point	55–60 °C	60–65 °C
Ageing in vitro	2–5 days	6 days

[1] Three independent experiments.

Tabel 2. Samenvatting van de bepalingen van het infectievermogen in uitgeperst sap.

Electron microscopy. Morphology and size of the particles were studied in crude sap with tobacco mosaic virus added as a magnification standard. Flexuous, elongate particles could be easily found although never in high concentration. The average size of 28 particles of B53 was 730 nm, of 60 particles of B54 723 nm and of 19 particles of NL1 723 nm.

Serology. Results of the micro-precipitin tests, employing an antiserum to the Jolanda strain (NL5) of BCMV and an antiserum to a typical strain (B25) of BYMV are summarized in Table 3. B53 turned out to be closely related to the NL5 strain of BCMV, but only distantly to BYMV-B25. B54 reacted equally well with antisera to BCMV and to BYMV.

Table 3. Summary or three serological tests performed by D. Z. Maat, serologist IPO. (Figures represent reaction titres; homologous reactions in italics.)

Antigens	Antisera		
	BCMV-NL5[3], nr. 7553	BYMV-B25[4], nr. 7246	Normal serum
1976-6-3			
BCMV-NL5[1]	*1024*	256	0
BYMV-B25[1]	16	*1024*	1
B53[2]	1024	16	1
healthy control[2]	16	16	1
1976-6-9			
BCMV-NL5[1]	*4096*		
BYMV-B25[1]		*1024*	
B54[2]	64	64	1
healthy control[2]	16	16	
1976-8-5			
B53[2]	256	0	0
B54[2]	64	64	0
BCMV-NL1[2]	64	0	0
healthy control[2]	0	0	0

[1] Purified virus suspension.
[2] Clarified plant sap, sap expressed in 0.5 M Tris buffer pH 8 and centrifuged for 10 minutes at 6000 rpm.
[3] NL5, the Jolanda strain of BCMV described by Hubbeling (1972).
[4] Strain of BYMV described by Bos (1970a).

Tabel 3. Samenvatting van drie serologieproeven, uitgevoerd door D. Z. Maat, seroloog IPO. (De getallen geven de reactietiters weer; homologe reacties cursief.)

Insect transmission. Result are recorded in Table 4. Insect transmission rates were low. Sometimes infection still (or only) occurred after the first $^1/_2$ h inoculation feeding period.

Seed transmission. Seeds were harvested several times from 'Dubbele Witte' plants, inoculated at the seedling stage with either B53 or B54. Seed infection always occurred and varied from ca 20 to 80% of the seeds harvested from infected plants. In this cultivar the two isolates did not differ in rate of transmission.

Table 4. Summary of aphid-transmission tests.

Aphid species	Virus isolate					
	B53 transfer:		B54 transfer:		NL1 transfer:	
	first[1]	second[2]	first	second	first	second
Aphis fabae	1/8[3]	2/8	0/8	4/8		
Myzus persicae			A.[4]1/5		0/5	0/5
	12/15	1/15	B.[4]0/15	0/15		

[1] First transfer (inoculation feeding) lasted for ½ h.
[2] Second transfer (inoculation feeding) from ½ h to overnight.
[3] Number of *Phaseolus* plants showing symptoms over number of plants inoculation fed with 10 aphids each ('Bataaf' was used for B53, 'Michelite' for B54, and 'Dubbele Witte' for NL1).
[4] Two independent experiments A and B.

Tabel 4. Samenvatting van de proeven tot overbrenging met bladluizen.

Strain differentiation. The results of nine bean varietal reaction tests are summarized in Table 5, as far as a direct experimental comparison of Dutch strains, including the isolates B53 and B54, is concerned. Local reactions were not found to be of importance to differentiate between strains and are not recorded in this table.

If susceptible, the first five couples of cultivars always reacted with systemic mosaic (+). Some were susceptible to infection but tolerant, showing questionable symptoms with virus recoverable by back inoculation onto 'Dubbele Witte' (±). In case of susceptibility, the cultivars listed from 6 to 9 inclusive reacted with systemic necrosis (+n, black-root disease), but in a number of instances in some plants only (±n).

In literature thirteen strains have been described in other countries. They are listed in Table 6 together with literature data on their reaction on several of the bean differentials of Table 5 and some related cultivars grouped as in Table 5. Comparisons are made between these reactions and those of the given cultivars to B53 and B54 (first two columns) as found in our present experiments.

Discussion

First of all, both isolates B53 and B54 are concluded to be isolates of BCMV. They have various features in common with the type strain (NL1) of BCMV. They are seed-borne and aphid transmitted. Their particles are flexuous and typical of the potyvirus group. The isolates therefore differ from spherical viruses that are sometimes seed-borne in bean and that may produce bean common mosaic-like symptoms, such as bean southern mosaic virus (Férault et al., 1969) and a bean strain of cucumber mosaic virus (Bos and Maat, 1974).

They differ also from bean yellow mosaic virus (BYMV) in their very limited host range, especially in not infecting pea cultivars sensitive to all strains of BYMV and in not producing symptoms in *Vicia faba*. Local lesions by B53 in *Chenopodium amaranticolor* and *C. quinoa* and latent infection of both isolates in *Nicotiana clevelandii* and *Gomphrena globosa* are not uncommon for BCMV in view of the results with the Westlandia strain (NL1), also recorded in Table 1, and earlier reports by

Table 5. Differentiation of B53 and B54 from previously described Dutch strains.

Host group	Differential cultivars	Virus isolates and strains								
		NL1 West-landia	B53	NL6 Colana	B54	NL2 Imuna	RM	NL3 Miche-lite	NL5 Jolan-da	NL4 Great North.
1	Dubbele Witte	+	+	+	+	+	+	+	+	+
	Str. Green Refugee	+	+	+	+	+	+	+	+	+
2	Puregold Wax	-	+	+	-	+	+	±	+	+
	Imuna	-	+	+	-	+	+	±	+	+
3	Redlands Greenleaf B	-	-	+	-	-	-	+	+	+
	Great Northern U.I.123	-	-	+	-	-	-	±	±	+
4	Michelite 62	-	-	-	+	+	+	+	+	-
	Sanilac	-	-	-	+	+	+	+	+	-
5	Great Northern U.I. 31	-	-	-	-	-	-	-	-	+
	Red Mexican U.I. 35	-	-	-	-	-	-	-	-	+
6	Jubila	-	-	+n	-	±n	±n	+n	+n	-
7	Topcrop	-	-	±n	-	±n	±n	+n	+n	-
	Impr. Tendergr. 40031	-	-	±n	-	±n	±n	+n	+n	-
8	Widusa	-	-	±n	+n	-	-	+n	+n	-
	Black Turtle Soup	-	-	±n	+n	-	-	+n	+n	-
9	Amanda	-	-	-	-	-	-	-	+n	-

+ = susceptible: systemic mosaic; +n = susceptible: systemic necrosis.
± = tolerant: systemic symptoms questionable or very weak, systemic virus recoverable by back inoculation; ±n = variable systemic necrosis, reaction in all plants requires temperatures over 26°C.
- = resistant: no systemic symptoms, systemic virus not recovered by back inoculation.

Tabel 5. Differentiatie van B53 en B54 van eerder beschreven Nederlandse stammen.

Quantz (1961) and Bos (1970a; see also Bos, 1971a). Dissimilar to BYMV is the very late appearance of symptoms by B53 in *Chenopodium* spp. *Tetragonia expansa*, producing local lesions with both B53 and B54, also did with the Westlandia strain (NL1) and is a new local-lesion host to BCMV.

Most data on persistence of infectivity in sap of B53 and B54 are in line with BCMV and other members of the potyvirus group. B54, however, differs in its surprisingly high dilution end point. In this respect, it resembles white clover mosaic virus, but that virus has shorter particles, occurs in higher concentrations when studied in the electron microscope and is not insect transmitted.

Aphid transmission of B54, both with *Aphis fabae* and *Myzus persicae*, was poor as was the case with B53 and *A. fabae*, but efficiency of aphid transmission of the related BYMV is known to depend greatly on virus strain and aphid biotype and even to get lost with certain isolates (Bos, 1970b). Retention of some infectivity by the aphids both for B53 and B54 for at least half an hour seems unusual, but may have been due to lack of inoculation feeding during the first half hour of testing.

Serologically, B53 clearly behaves like BCMV. It is only distantly related to a typical strain (B25) of BYMV. Antisera to BCMV and BYMV reacted similarly to B54 antigen, suggesting an intermediate position of B54. This is not surprising in view of the rather close serological relationship between BCMV and BYMV (Bercks, 1960). See also Table 3, first experiment.

The next question concerns the differentiation of B53 and B54 as strains of BCMV. Table 5 shows that on bean differential cultivars they both differ from each other as well as from all other Dutch strains described so far. B53 was of low pathogenicity and produced systemic mosaic in cultivar groups 1 and 2 only. B54 did so in groups 1 and 4, but also incited systemic necrosis in group 8. Hence, they can be easily distinguished from all known Dutch strains. The table also shows that the Imuna strain (NL2) described by Hubbeling (1963) is identical with the RM strain of Van der Want (1954).

Table 6 indicates that B53 differs from all foreign strains but the German P487 and P1075. However, these induced necrotic local lesions in detached leaves of 'Topcrop' (Quantz, 1957), which was not the case in a separate test with B53 not reported here. Unfortunately, the German isolates P48 and P1075 had not been tested on a representative of host group 2. B53 may be related to the Costa Rica and Peru strains, but these have been incompletely described, data on their reaction on host groups 2 and 3 lacking. B54 seems to differ completely from all foreign strains. A relationship might exist with the strains Voldagsen and Marienau, but the reactions of host group 2 to these German strains is unknown, as is the reaction of host group 3 to strain Marienau, while it is not clear whether 'Michelite' and 'RM34' are susceptible to the latter strain or not.

Thus, the two isolates B53 and B54 differ from existing Dutch strains and very probably also from strains described elsewhere. Therefore, they are considered new strains of BCMV. In line with the strain denotation NL1–NL6, the new strains will be designated as NL7 and NL8, respectively. NL8 (B54) seems unique in its extremely high dilution end point, its serological behaviour and in its inability to infect *C. amaranticolor* and *C. quinoa*, but the latter two characters have not yet been thoroughly investigated for all other strains of the virus.

Table 6. Comparison of B53 and B54 in bean cultivar reaction with literature data on thirteen strains of BCMV.

Host group	Differential cultivars	Virus isolates and strains			
		B53	B54	Type	New York 15
1	Dubbele Witte	+	+		
	Str. Green Refugee	+	+	+10, 13, 15	+10, 13, 15
	Saxa	+	+		
	Wachs Rheinland	+	±		
2	Puregold Wax	+	−	−7, 11, 13, +15	+7, 11, 13, 15
	Imuna	+	−	−15	−15
3	Great Northern U.I. 123	−	−	−2, 4, 7, 11, 13, ±15	−2, 4, 7, 11, 13, 15
	Great Northern U.I. 59	−	−	−1, 2, 4, 7, 11	−1, 2, 4, 7, 11
4	Michelite	−	+	−1, 2, 3, 10, 13, 15	+1, 2, 3, 10, 13, 15
	Sanilac	−	+	−10, 13, 15	+10, 15, −13
	Red Mexican U.I. 34	−	+	−2, 3, 4, 7, 10, 11, 13, ±15	+2, 3, 4, 7, 10, 11, 13, 15
	Pinto U.I. 111	−	+	−4, 7, 10, 11, 13, ±15	+4, 7, 10, 11, 13, 15
	Great Northern U.I. 15	−	+	−1, 2, 3, 4	+1, 2, 3, 4
	Robust	−	+	−1, 2	+1, 2
5	Great Northern U.I. 31	−	−	−3, 4, 7, 11, 13	−3, 4, 7, 11, 13
	Red Mexican U.I. 35	−	−	−13, 15	−13, ±15
	Monroe	−	−	−15	−15
7	Topcrop	−	−	−7, 11, 13, ±15	−7, 11, 13, ±15
	Impr. Tendergreen	−	−	+7, 11, ±13	−7, 11, 13

\+ = susceptible, systemic mosaic.
± = tolerant, systemic symptoms questionable or very weak, systemic virus recoverable by back inoculation.
−? = literature data on this cultivar not clear.
1 = Richards and Burkholder (1943); 2 = Dean and Hungerford (1946); 3 = Frandsen (1952); 4 = Hungerford (1952); 5 = Rudorf (1955); 6 = Rudorf (1958); 7 = Dean and Wilson (1959); 8 = Skotland and Burke (1961); 9 = Quantz (1961); 10 = Zaumeyer and Goth (1964); 11 = Bagget et al. (1966); 12 = Moreno et al. (1968); 13 = Silbernagel (1969); 14 = Gamez et al. (1970); 15 = Alconero and Meiners (1974).

Tabel 6. Vergelijking van B53 en B54 in hun reactie op toetsrassen met literatuurgegevens over dertien stammen van BCMV.

Finally, it should be noted – as Table 6 clearly demonstrates – that literature data are often conflicting. This may be due to: (1) the use of genetically impure bean cultivars, (2) use of plants already infected from the seed with contaminant strains, (3) the use of contaminated inoculum (complex infection), (4) the use of low-titre inoculum, (5) differences in recording of results because of different interpretations of the terms resistant, tolerant and susceptible, (6) different ways of determining these characters, and (7) study under different climatic conditions. Moreover, too often test ranges have been used that were too narrow in the light of present results. Hence, standardization of the identification of strains of BCMV, as already suggested by Bos (1971b), is urgently needed.

Vol-dagsen	Marie-nau	P487	P1075	Costa Rica	Peru	Puerto Rico	Florida	Idaho	Western	Mexi-can
		+9	+9							
				+12, 14	+14	+15	+10, 13, 15	+7	+13	+13
+3	+3	+9	+9							
+3	−3									
						+15	−13, +15	+7	+11, 13	+13
						±15	±15			
−5		−9	−9			±15	−10, 13, 15	+7	+8, 11, 13	+13
		−9	−9				−10	+7		
+3	−?3			−12, 14	−14	−15	−10, 13, 15		−8, 13	+13
				−12, 14	−14	−15	−10, 13, ±15		−8, 13	−13
+3	−?3	−9	−9			±15	−10, 13, +15	+7	−8, 11, 13	−13
		−9	−9	−12, 14	−14	±15	−10, 13, 15	+7	−8, 11, 13	±13
−3, 5	−3	−9	−9							
+3	+3									
−3	−3	−9	−9		−14		−13	+7	−8, 11, 13	+13
						±15	−13, ±15		−8, ±13	+13
						−15	±15			
−6	−6	−9	−9	−12, 14	−14	±15	−13, ±15	−7	−8, 11, 13	−13
							+13	+7	+8, 11, 13	−13

Samenvatting

De identificatie van twee nieuwe stammen van het bonerolmozaïekvirus

Twee met sap overgaande virusisolaten uit boon *(Phaseolus vulgaris)* (B53 uit in de kas uit Peruaans zaad opgekweekte planten en B54 uit planten van een Nederlandse bonekruising) werden geïdentificeerd als bonerolmozaïekvirus (BCMV). Dit gebeurde op grond van deeltjesgrootte en -vorm, serologische eigenschappen (Tabel 3), houdbaarheid van het infectievermogen in uitgeperst plantesap (Tabel 2),overdracht door bladluizen (Tabel 4), beperkte waardplantenreeks (Tabel 1) en symptomen (Fig. 1–3) en zaadoverdracht in boon.

In reactie op differentiërende bonerassen verschilden beide isolaten van elkaar en van alle zes andere, tot dusver in Nederland beschreven stammen van BCMV (Tabel 5). Uitgaande van gegevens uit de literatuur lijken ze ook te verschillen van de dertien elders beschreven stammen (Tabel 6). B53 lijkt wel wat op stammen uit Costa Rica en Peru, maar deze zijn onvolledig beschreven.

De twee in Wageningen verkregen isolaten worden daarom opgevat als nieuwe stammen en aangeduid als BCMV-NL7 en BCMV-NL8. De laatste wijkt sterk af

door zijn ongewoon hoge verdunningseindpunt, in zijn even sterke serologische verwantschap met het bonerolmozaïekvirus als met het bonescherpmozaïekvirus (Tabel 3) en in het niet kunnen aantasten van *Chenopodium amaranticolor* en *C. quinoa*.

Tetragonia expansa werd ontdekt als een nieuwe lokale-lesieplant voor het bonerolmozaïekvirus.

Geconstateerd wordt dat er een grote behoefte bestaat aan internationale standaardisatie in de beschrijving van de stammen van het virus.

References

Alconero, R. & Meiners, J. P., 1974. The effect of environment on the response of bean cultivars to infection by strains of bean common mosaic virus. Phytopathology 64: 679–682.

Baggett, J. R., Frazier, W. A. & McWhorter, F. P., 1966. Sources of virus resistance in beans. Pl. Dis. Reptr 50: 532–536.

Bercks, R., 1960. Serologische Untersuchungen zur Differenzierung von Isolaten des *Phaseolus*-Virus 2 und ihrer Verwandschaft mit *Phaseolus*-Virus 1. Phytopath. Z. 39: 120–128.

Bos, L., 1970a. The identification of three new viruses isolated from *Wisteria* and *Pisum* in the Netherlands, and the problem of variation within the potato virus Y group. Neth. J. Pl. Path. 76: 8–46.

Bos, L., 1970b. Bean yellow mosaic virus. C.M.I./A.A.B. Descr. Pl. Viruses, no. 40, 4 pp.

Bos, L., 1971a. Bean common mosaic virus. C.M.I./A.A.B. Descr. Pl. Viruses, no. 73, 4 pp.

Bos, L., 1971b. Circular letter to members of the International Working Group on Legume Viruses involved in research on BCMV, May 14, 1971.

Bos, L., Hagedorn, D. J. & Quantz, L., 1960. Suggested procedures for international identification of legume viruses. Tijdschr. Plziekt. 66: 328–343.

Bos, L. & Maat, D. Z., 1974. A strain of cucumber mosaic virus, seed-transmitted in beans. Neth. J. Pl. Path. 80: 113–123.

Dean, L. L. & Hungerford, C. W., 1946. A new bean mosaic in Idaho. Phytopathology 36: 324–326.

Dean, L. L. & Wilson, V. E., 1959. A new strain of common bean mosaic in Idaho. Pl. Dis. Reptr 43:1108–1110.

Drijfhout, E., 1977. Genetic interaction between *Phaseolus vulgaris* L. and bean common mosaic virus and its strains. Agric. Res. Rep. 872, Pudoc, Wageningen.

Drijfhout, E. & Silbernagel, M. J., 1977. Identification and classification of strains of bean common mosaic virus. Neth. J. Pl. Path. 83: in manuscript.

Férault, A. C., Spire, D., Bannerot, H., Bertrandy, J. & Le Tan, T., 1969. Identification dans la région parisienne d'une marbrure du haricot comparable au bean southern mosaic virus (Zaumeyer et Harter). Annls Phytopath. 1: 619–626.

Frandsen, N. O., 1952. Untersuchungen zur Virusresistenzzüchtung bei *Phaseolus vulgaris* L. 1. Phytopathologische Untersuchungen. Z. PflZücht. 31: 381–420.

Gamez, R., Osores, A. & Echandi, E., 1970. Una raza nueva del virus del mosaico común del frijol. Turrialba 20: 397–400.

Hubbeling, N., 1963. Complicaties bij de toetsing van bonerassen op resistentie tegen *Phaseolus* virus 1 ten gevolge van het voorkomen van afwijkende virusstammen. Meded. LandbHoogesch. OpzoekStns Gent 28: 1025–1033.

Hubbeling, N., 1972. Resistance in beans to strains of bean common mosaic virus. Meded. Fak. LandbWetensch. Gent 37: 458–466.

Hungerford, C. W., 1952. Disease resistant field beans for Idaho. Circ. Idaho agric. Exp. Stn 118: 11 pp.

Moreno, R., Gamez, R. & Gonzalez, L. C., 1968. El virus del mosaico común del frijol (*Phaseolus vulgaris* L.) en Costa Rica. Turrialba 18: 257–263.

Quantz, L., 1957. Ein Schalentest zum Schnellnachweis des gewöhnlichen Bohnenmosaikvirus (*Phaseolus*-Virus 1). NachrBl. dt. PflSchutzd. Stuttg. 9: 71–74.

Quantz, L., 1961. Untersuchungen über das gewöhnliche Bohnenmosaikvirus und das Sojamosaikvirus. Phytopath. Z. 43: 79–101.

Richards, B. L. & Burkholder, W. H., 1943. A new mosaic disease of beans. Phytopathology 33: 1215–1216.
Rudorf, W., Die Übertragung der Resistenz gegen die Bohnenmosaikviren 1 (gewöhnliches Bohnenmosaik) und 2 (gelbes Bohnenmosaik) aus *Phaseolus coccineus* in fertile Bastardpflanzen aus der Kreuzung *Phaseolus vulgaris* × *Phaseolus coccineus*. Naturwissenschaften 42: 19–20.
Rudorf, W., 1958. Ein Beitrag zur Genetik der Resistenz gegen das Bohnen-Mosaikvirus 1. Phytopath. Z. 31: 371–380.
Silbernagel, M. J., 1969. Mexican strain of bean common mosaic virus. Phytopathology 59: 1809–1812.
Skotland, C. B. & Burke, D. W., 1961. A seed-borne bean virus of wide host range. Phytopathology 51: 565–568.
Want, J. P. H. van der, 1954. Onderzoekingen over virusziekten van de boon (*Phaseolus vulgaris* L.). Meded. Inst. plziektenk. Onderz. 85: 84 pp.
Zaumeyer, W. J. & Goth, R. W., 1964. A new severe symptom-inducing strain of common bean mosaic virus. Phytopathology 54: 1378–1385.

Addresses

E. Drijfhout: Instituut voor de Veredeling van Tuinbouwgewassen (IVT), Postbus 16, Wageningen, the Netherlands.
L. Bos: Instituut voor Plantenziektenkundig Onderzoek (IPO), Postbus 42, Wageningen, the Netherlands.