Arch Virol 139 (1994)

VDN
Virology Division News

Taxonomy and classification of legume-infecting potyviruses*

A proposal from the Potyviridae Study Group of the Plant Virus Subcommittee of ICTV

Historical perspective and definition of the problem

The Potyviridae Study Group of the Plant Virus Subcommittee (PVS) of ICTV held a workshop in Braunschweig, Germany, in September 1990. Participants agreed on the family and general concepts and as a result the family *Potyviridae* with three genera was approved by the ICTV Executive Committee. Workshop participants did not agree on criteria for establishing virus species. A suggestion to evaluate the details of specific criteria within a group of well studied virus variants was accepted by the participants. The accumulation of a significant knowledge base for viruses such as bean common mosaic virus, cowpea aphidborne mosaic virus, blackeye cowpea mosaic virus, peanut stripe virus and soybean mosaic virus indicates that the "BCMV" subgroup of the *Potyviridae* presents a unique opportunity to address the issues that extend the taxonomy and classification of potyviruses to the virus species and strain level.

Drs. G. J. Mink and M. J. Silbernagel organized a workshop on speciation within the subgroup in conjunction with a meeting of the International Working Group on Legume Viruses (IWGL; 25–27 July, 1993, Montreal) to review the criteria currently used to distinguish virus species, pathotypes, strains, etc in this subgroup. The following is a recommendation from this workshop concerning names for the two species currently known as BCMV and the species composition in the BCMV subgroup. This recommendation was reviewed and approved by workshop participants and the Potyviridae Study Group after review by the Plant Virus Subcommittee of ICTV.

For over 20 years, legume virologists have known that isolates identified biologically as BCMV actually represented more than one distinct entity. Information now available from sequence data, serology, and biological/biophysical properties clearly shows that "BCMV" consists of two distinct virus species: one that consists of isolates commonly referred to as serotype 'A', which may cause temperature insensitive necrosis in bean cultivars possessing the dominant *I* gene and different combinations of strain-specific recessive genes. The second includes many isolates commonly included as BCMV serotype 'B'. The above criteria also indicate that isolates of the following viruses should be included within this latter virus (see Fig. 1):

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* This is a consensus of the BCMV working group composed by a subgroup consisting of G. I. Mink, H. J. Vetten, C. W. Ward, P. H. Berger, F. J. Morales, J. M. Myers, M. J. Silbernagel, and O. W. Barnett.

AzMV
BlCMV
PStV (including soybean potyvirus isolates from Taiwan)

Using the above criteria, it is clear that a number of other viruses are closely related yet distinct species from the two listed above (see also Fig. 1). These are:

SbMV (possibly including WMVII)
PWV
ZYMV
SAPV
CABMV

These 7 virus species are more closely related to each other using all of the above criteria than they are to any of the other members of the *Potyviridae*. Application of the above criteria to other members of the *Potyviridae* reveals that there are other closely related clusters of virus species, such as the PVY, BYMV, PPV, and SCMV subgroups.

Criteria employed to discriminate species and strains

I. Sequence data

While most of the sequence data available to date has come from the coat protein (CP) and 3′-end noncoding region (NCR), any sizable portion of the potyvirus genome can be used, keeping in mind that the P1, P3 and the CP N-terminal region are hypervariable. Pairwise sequence comparisons readily discriminate genera, species and strains as shown in Fig. 3.

II. Serology

Species-specific monoclonal antibodies are now available for:

The serogroup A isolates (e.g., I-2)
The serogroup B isolates (e.g., 5E5)
Cowpea aphidborne mosaic virus isolates (e.g., 5H5),

and have been used to show that one PStV isolate and several CABMV isolates have been mislabeled (see also Fig. 2). Such reagents will enable the authenticity of other isolates of these viruses to be confirmed rapidly.

III. Biological and biophysical properties

While sequence data are the major criteria for discriminating between virus species and strains, biological and biophysical properties are of major importance in discriminating among strains and establishing whether a new isolate is a distinct strain or a variant of an existing one. Of particular importance are pathogenic reactions with panels of differential plant genotypes.

Nomenclature

In our discussions of the nomenclatural implications of these virus re-assignments, the current ICTV guidelines were kept in mind. It was also agreed that the new names should accurately describe the new species/strain/variant/isolate status as well as allow ready

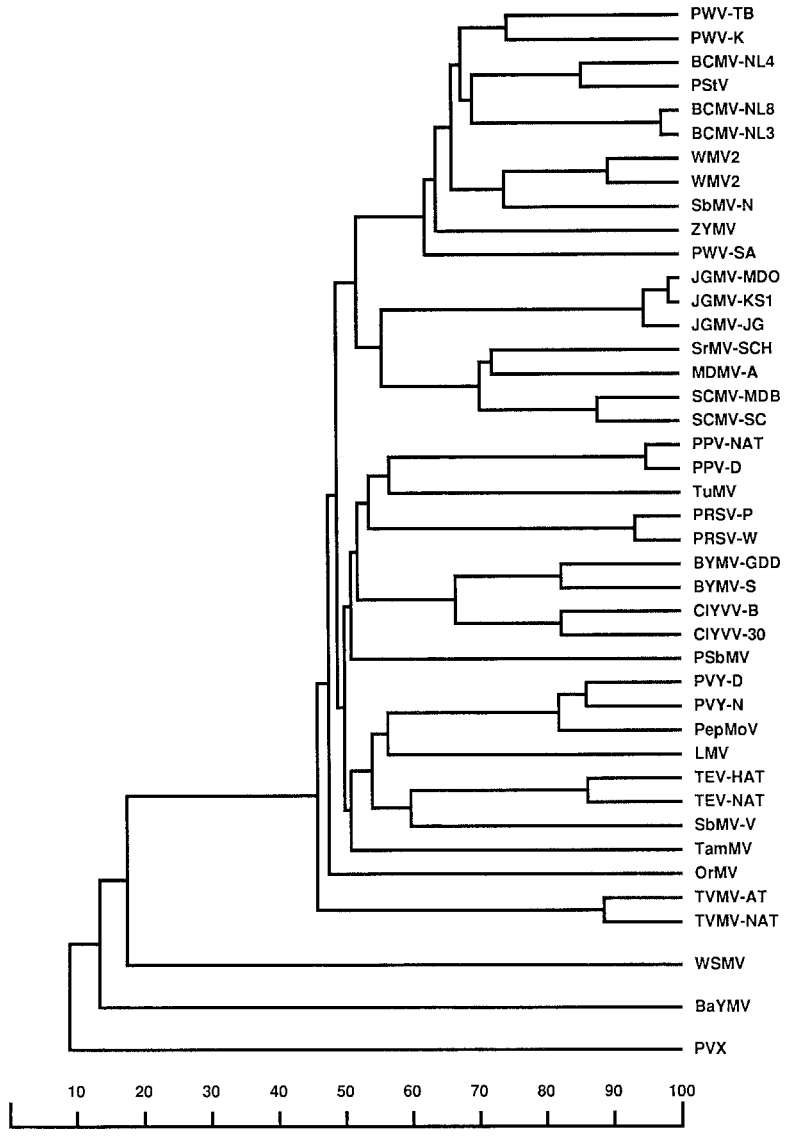

Fig. 1. Sequence relationship dendrogram (phylogenetic tree) produced using CLUSTAL from alignments of the total coat protein amino acid sequences of 39 generic potyviruses, WSMV (= genus *Rymovirus*), BaYMV (= genus *Bymovirus*) and PVX (a potexvirus). Vertical distances in the tree are arbitrary, horizontal distances are proportional to percent amino acid sequence divergence, shown in the scale below the figure

connection with the past literature. The name for the BCMV serotype B virus should remain unchanged (BCMV).

There was general agreement that the nomenclature for the former AzMV, BlCMV, PStV, and Taiwan soybean isolates be shown as in the following examples:

BCMV-Az-(isolate descriptor)
BCMV-BlC-Fl
BCMV-PSt-Bl
BCMV-Sb74

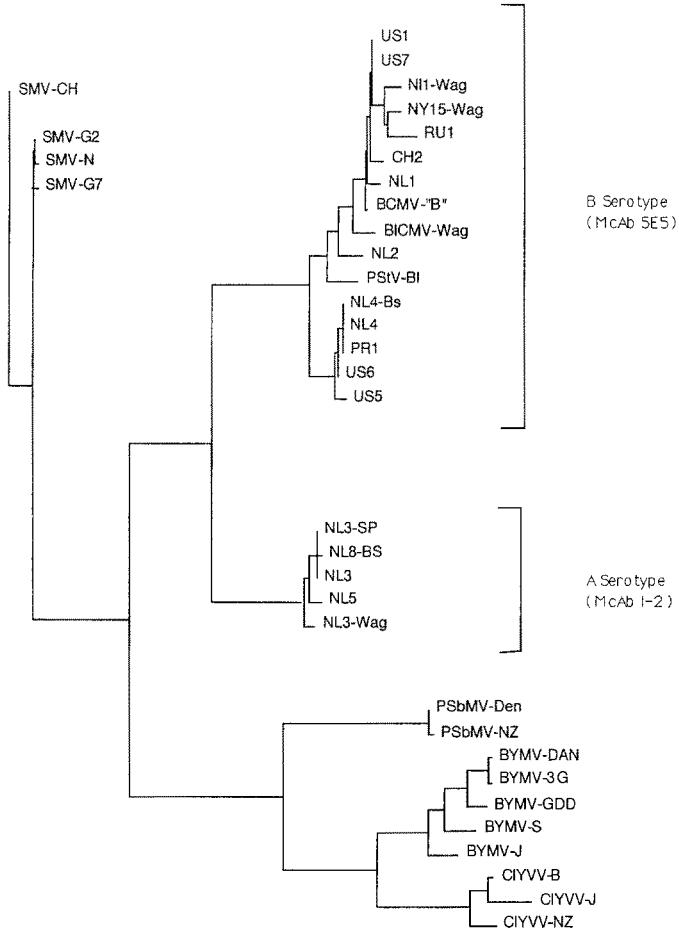

Fig. 2. Most parsimonious tree of legume-infecting potyvirus coat protein amino acid sequences, showing serotype specificity by two monoclonal antibodies (Berger and Wyatt, unpubl.)

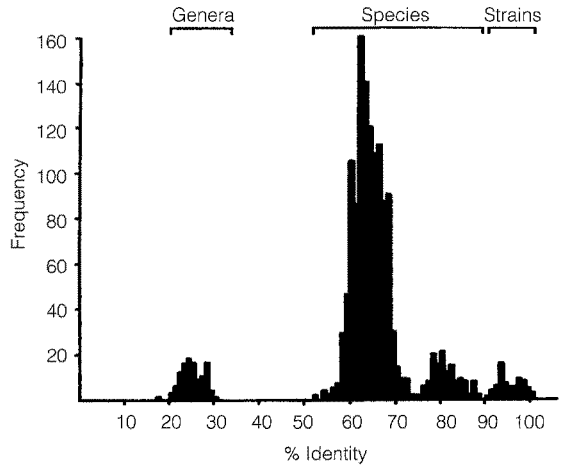

Fig. 3. Reproduced from Ward CW and Shukla DD. In: Rishi et al. (eds) Proceedings of the International Congress on Virology in the tropics, Lucknow, India, 1991. Malhotra Publishing House (in press)

There was a consensus that the name for the BCMV serotype A virus should be changed to bean common mosaic necrosis virus (BCMNV). In the case of these isolates, they should be designated as in the following examples:

BCMNV-NL3-(isolate descriptor)
BCMNV-NL8-Drij
BCMNV-NL8-Id
BCMNV-TN1

Such acronyms not only indicate the dominant host but allow ready connection with the past designations.

Conclusions

The conclusions are:

1) That the former BCMV serotype A isolates now constitute a distinct virus species (BCMNV).
2) That the former BCMV serotype B isolates along with AzMV, BlCMV, PStV and the Taiwan soybean isolates constitute a distinct virus species (BCMV).
3) That the BCMV subgroup includes BCMNV, BCMV, SbMV, PWV, ZYMV, SAPV, and CABMV.

The above conclusions were accepted by a majority of the members of IWGLV in attendance at the Montreal meeting.