

Virus taxonomy update

Taxonomic decisions ratified at the Plenary Meeting of the ICTV at the 9th International Congress of Virology held in Glasgow on the 10th August 1993

The International Committee on Taxonomy of Viruses (ICTV) was founded at the International Congress of Microbiology in Moscow in 1966. Subsequently the ICTV became permanently associated with the Virology Division of the International Union of Microbiological Societies (IUMS) when it was formally established at the 1st International Congress of Virology held in Helsinki in 1968. In the years since then the ICTV has endeavoured to develop a universally acceptable system of virus taxonomy. Today, the ICTV operates through an Executive Committee with seven Sub-committees and 45 Study Groups, involving the participation of more than 376 virologists representing all fields of virology and drawn from many nationalities. The Executive Committee meets regularly between Virology Congresses and prepares taxonomic proposals for ratification at the Plenary Session which is held triennially during the course of the International Congress and which involved the entire membership of the ICTV. Sixty-one proposals were received from Study Groups since the last Virology Congress and fifty-five were presented for final consideration at the 9th International Congress of Virology in Glasgow. Cumulatively, these proposals bring the universal system for virus taxonomy to one Order, 50 Families, 9 sub-families, 126 Genera, 23 floating Genera and 2 Subgenera. The 6th Report of the ICTV which is scheduled to be published by Springer-Verlag in early 1994 will include all these recent taxonomic changes and present the current taxonomy of viruses in a revised and expanded format.

The taxonomic proposals ratified by the Plenary Meeting of the ICTV at the 9th International Congress of Virology in Glasgow are the following:

Bacterial viruses

The Chlamydia phages

1. To establish a new genus within the family *Microviridae*
2. To name the new genus *Chlamydiamicrovirus*
3. To designate *Chlamydia* phage Chp 1 as type virus of the genus

The Mac-1 type phages

1. To establish a new genus within the family *Microviridae*
2. To name the genus containing Mac-1 and related phages *Bdellomicrovirus*
3. To establish Mac-1 as the type species of the genus

The SSV-1 type phages

1. To name the family containing SSV-1 type phages *Fuselloviridae*
2. To name the SSV-1 group genus *Fusellovirus*

Protozoal and fungal viruses*Totiviruses*

1. To revise the classification of the *Giardiavirus* genus of dsDNA protozoal viruses from a possible genus in the family *Totiviridae* to a legitimate genus
2. To establish a new genus of isometric dsRNA viruses of the parasitic protozoan *Leishmania braziliensis* within the family *Totiviridae*
3. To name the genus *Leishmaniavirus*
4. To designate Leishmania RNA Virus 1-1 (LRV1-1) as the type species of the genus

Bacilliform viruses of fungi

1. To establish a new family of ssRNA bacilliform viruses of fungi
2. To name the family the *Barnaviridae*
3. To establish one genus within the family *Barnaviridae*
4. To name the genus *Barnavirus*

Cryphonectria parasitica viruses

1. To establish a family of RNA viruses known to be the determinants of hypovirulence in the chestnut blight fungus *Cryphonectria parasitica*
2. To name the family *Hypoviridae*
3. To establish one genus within the family
4. To name the genus *Hypovirus*
5. To designate *Cryphonectria hypovirus* 1-713 (CHVI-713) as the type species

Penicillium chrysogenum virus group

1. To revise the classification of the *Penicillium chrysogenum* virus group from a possible genus in the family *Partitiviridae* to a genus in the family
2. To name the genus *Chrysovirus*

Joint proposal of the fungal virus and plant virus sub-committee

1. To merge the Cryptovirus group with its two genera *Alphacryptovirus* and *Betacryptovirus* with the established family *Partitiviridae* with its two genera *Partitivirus* and *Chrysovirus*

Plant viruses*Machlomoviruses*

1. To establish a new genus of plant viruses with icosahedral particles and monopartite ssRNA
2. To name the genus *Machlomovirus*
3. To designate maize chlorotic mottle virus as the type species of the genus *Machlomovirus*

Idaeoviruses

1. To establish a new genus of plant viruses with small deformable isometric particles and a bipartite ssRNA genome
2. To name the genus *Idaeovirus*
3. To designate raspberry bushy dwarf virus as the type species of the genus *Idaeovirus*

Trichoviruses

1. To establish a new genus of plant viruses with highly flexuous filamentous particles and monopartite ssRNA genomes
2. To name the genus *Trichovirus*
3. To designate apple chlorotic leaf spot virus as the type species of the genus

Umbraviruses

1. To establish a new genus of plant viruses apparently deprived of conventional particles, and dependent for transmission on a helper virus
2. To name the genus *Umbravirus* (from Latin *umbra*, a shadow, an uninvited guest that comes with an invited one)
3. To designate carrot mottle virus as the type species of the genus

Sequiviruses

1. To establish a new family of plant viruses with icosahedral particles, monopartite ssRNA genomes and protein coats with three distinct polypeptides
2. To name the family *Sequiviridae*
3. To place the genera *Sequivirus* and *Waikavirus* in this family
4. To name the genus corresponding to the former maize chlorotic dwarf virus group *Waikavirus* (a name derived from the Japanese “waika” (stunt) to describe the diseases induced by rice tungro spherical virus)
5. To designate rice tungro spherical virus as the type of species of the genus

Rhabdoviruses

1. To name *Cytorhabdovirus* and *Nucleorhabdovirus* the genera of plant rhabdoviruses corresponding to the current subgroups A and B, respectively

Cryptoviruses

1. That the *Cryptovirus* group be abolished
2. That its two constituent gener *Alphacryptovirus* and *Betacryptovirus* be moved to the family *Partitiviridae*

General proposal for the revision of plant virus taxonomy: To adapt the current “group-virus” classification of plant viruses to the traditional taxonomic system based on “family-genus-species”, and to establish a new classification and nomenclature of plant viruses as follows:

Invertebrate viruses

1. To revise the classification of the family *Baculoviridae* so that it becomes a single family with two genera *Nucleopolyhedrovirus* and *Granulovirus*
2. Deletion of the subgenus "Single Nucleocapsid" from the genus "Nuclear Polyhedrosis Virus"
3. Deletion of the subgenus "Multiple Nucleocapsid" from the genus "Nuclear Polyhedrosis virus"
4. Replacement of the genus name "Nuclear polyhedrosis Virus" by "Nucleopolyhedrovirus"
5. Deletion of the subfamily "*Nudibaculovirinae*" from the family *Baculoviridae*
6. Deletion of the genus name "Non-occluded baculoviruses"
7. Replacement of the genus name "Granulosis viruses" by *Granulovirus*
8. Deletion of the subfamily *Eubaculovirinae* from the family *Baculoviridae*

Vertebrate viruses*Birnaviruses*

1. To establish the genus *Aquabirnavirus* in the family *Birnaviridae*
2. To establish the genus *Avibirnavirus* in the family *Birnaviridae*
3. To establish the genus *Entombirnavirus* in the family *Birnaviridae*

Hepatitis viruses

1. To establish the genus *Deltavirus*
2. To designate hepatitis delta virus as the type virus in the genus *Deltavirus*

Herpesviruses

1. To establish the genus *Roseolovirus* in the subfamily *Betaherpesvirinae* of the family *Herpesviridae*
2. To establish human herpesvirus 6 as the type of species of the genus *Roseolovirus*

Parvoviruses

1. To establish the subfamilies *Parvovirinae* and *Densovirinae* in the family *Parvoviridae*
2. To establish the genus *Erythrovirus* in addition to the genera *Parvovirus* and *Dependovirus* in the subfamily *Parvovirinae*
3. To establish the genera *Densovirus*, *Iteravirus* and *Contravirus* in the subfamily *Densovirinae*

Rhabdoviruses

1. To establish the genus *Cytorhabdovirus* in the family *Rhabdoviridae*
2. To establish the genus *Nucleorhabdovirus* in the family *Rhabdoviridae*
3. To establish the genus *Ephemerovirus* in the family *Rhabdoviridae*
4. To establish bovine ephemeral fever virus as the type species of the genus *Ephemerovirus*

Other business completed at the Plenary Meeting included election of Officers and Executive Committee for the next three years and revision and amendment of the Statutes of ICTV. The Statutes of the ICTV were amended as follows principally to provide greater flexibility in the conduct of business and to accelerate ratification of new taxonomic proposals. (The Statutes of the ICTV are reproduced in full in "Classification and Nomenclature of Virus", 5th Report of the ICTV, ed. Francki et al., Springer, Wien New York; Archives of Virology, Supplementum 2, pp 48–51, 1991).

Article 4, Section B: Add the sentence: "The Secretaries shall be elected for a period of six years, with provision for renewal at three year intervals."

Article 4, Section G: Add the sentence: "Study Group Chairpersons and Study Group members will be nominated for a period of three years."

Article 4: Add the following as Section H: "Finance Committee: A finance committee will be constituted comprising the Officers (President, Vice-President, the two Secretaries) and two nominated members. The nominated members will serve for a period of three years".

Article 6: Add the following to the third section: "or by circulation of proposals by mail followed by a postal vote."

Article 7: Add the following: "(iii) Voting members of the full ICTV comprise the Members of the Executive Committee, the National Members, the Life Members and the Chairpersons of the Sub-committees".

Article 8: Add the following: "or by circulation of proposals by mail followed by a postal vote."

The Officers and Executive Committee of the ICTV for the next three years are the following:

President:	F. A. Murphy
Vice-President:	D. H. L. Bishop
Secretaries:	C. Fauquet C. R. Pringle
Sub-committee Chairmen:	J. Maniloff (Bacterial Viruses) M. C. Horzinek (Database) R. Wickner (Fungal Viruses) E. Carstens (Invertebrate Viruses) M. A. Mayo (Plant Viruses) R. W. Compans (Vertebrate Viruses) The President <i>ex officio</i> (Coordination & Finance)
Committee Members:	H. W. Ackermann G. Adams L. Berthiaume C. H. Calisher R. Goldbach J. E. Johnson E. Koonin G. P. Martelli

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New families and genera of plant viruses

For a number of years plant virologists have been more circumspect about virus taxonomy than their animal or, to an extent, bacterial virologist colleagues. There has been a reluctance to adopt hierarchical structures, such as the species/genus/family arrangement, for the sound reason that information has been in many instances too scant. The result was that in the Vth ICTV Report (Francki et al. 1991) most plant viruses were assigned to "groups" which were not necessarily of equal taxonomic status. Some plant viruses have been classified in families originally formed to contain viruses of animals when the similarities were very striking between the plant and animal viruses. These are the plant rhabdoviruses (Sub-group A = *Cytorhabdovirus* and sub-group B = *Nucleorhabdovirus*), the plant reoviruses (*Phytoreovirus*, *Fijivirus* and *Oryzavirus*) and the *Tospovirus* genus in the *Bunyaviridae*.

In part because of changes to the Rules of Classification (Martelli 1992), and in part because of increasing amounts of molecular information about viruses in many groups, there has recently been a substantial change in the way plant viruses are classified. At the plenary session of ICTV held during the ICV in Glasgow these changes were ratified and will be incorporated into the forthcoming VIth Report of the ICTV. This note summarises the new classification.

Forty-seven genera of plant viruses are now recognised, most of which are the same as the old "virus groups". Twenty five are clustered into families. Of these, 17 are in 6 newly created families (Table 1). The other 8 genera are in existing families (Table 2), the only change from the previous classification being that the viruses in the old cryptic virus group have been added to the family *Partitiviridae* as 2 genera (*Alphacryptovirus* = sub-

Table 1. The new families of plant viruses

Viruses with a ssDNA genome	
<i>Geminiviridae</i>	Genus Subgroup I (type species maize streak virus)
	Genus Subgroup II (type species beet curly top virus)
	Genus Subgroup III (type species bean golden mosaic virus)
Viruses with a ssRNA genome	
<i>Tombusviridae</i>	Genus <i>Tombusvirus</i> (type species tomato bushy stunt virus)
	Genus <i>Carmovirus</i> (type species carnation mottle virus)
<i>Sequiviridae</i>	Genus <i>Sequivirus</i> (type species parsnip yellow fleck virus)
	Genus <i>Waikavirus</i> (type species rice tungro spherical virus)
<i>Comoviridae</i>	Genus <i>Comovirus</i> (type species cowpea mosaic virus)
	Genus <i>Nepovirus</i> (type species tobacco ringspot virus)
	Genus <i>Fabavirus</i> (type species broad bean wilt virus)
<i>Bromoviridae</i>	Genus <i>Bromovirus</i> (type species brome mosaic virus)
	Genus <i>Cucumovirus</i> (type species cucumber mosaic virus)
	Genus <i>Ilarvirus</i> (type species tobacco streak virus)
	Genus <i>Alfamovirus</i> (type species alfalfa mosaic virus)
<i>Potyviridae</i>	Genus <i>Potyvirus</i> (type species potato virus Y)
	Genus <i>Bymovirus</i> (type species barley yellow mosaic virus)
	Genus <i>Rymovirus</i> (type species ryegrass mosaic virus)

Table 2. Established families with some plant virus members

<i>Reoviridae</i>	<i>Phytoreovirus</i>
	<i>Fijivirus</i>
	<i>Oryzavirus</i>
<i>Rhabdoviridae</i>	<i>Cytorhabdovirus</i>
	<i>Nucleorhabdovirus</i>
<i>Bunyaviridae</i>	<i>Tospovirus</i>
<i>Partitiviridae</i>	<i>Alphacryptovirus</i>
	<i>Betacryptovirus</i>

Table 3. Plant virus genera not yet assigned to families

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1. Viruses with isometric particles and ssRNA genomes
 - a) monopartite genomes
 - Luteovirus* (type A – type species barley yellow dwarf virus)
 - Luteovirus* (type B – type species potato leafroll virus)
 - Sobemovirus* (type species southern bean mosaic virus)
 - Tymovirus* (type species turnip yellow mosaic virus)
 - Necrovirus* (type species tobacco necrosis virus)
 - Machlomovirus* (type species maize chlorotic mottle virus)
 - Marafivirus* (type species maize rayado fino virus)
 - b) bipartite genomes
 - Enamovirus* (type species pea enation mosaic virus)
 - Dianthovirus* (type species carnation ringspot virus)
 - Idaeovirus* (type species raspberry bushy dwarf virus)
 2. Viruses with filamentous particles and ssRNA genomes
 - Closterovirus* (type species beet yellows virus)
 - Capillovirus* (type species apple stem grooving virus)
 - Trichovirus* (type species apple chlorotic leafspot virus)
 - Carlavirus* (type species carnation latent virus)
 - Potexvirus* (type species potato virus X)
 - Tenuivirus* (type species rice stripe virus)
 3. Viruses with rod-shaped particles and ssRNA genomes
 - Tobamovirus* (type species tobacco mosaic virus)
 - Tobravirus* (type species tobacco rattle virus)
 - Furovirus* (type species soil-borne wheat mosaic virus)
 - Hordeivirus* (type species barley stripe mosaic virus)
 4. Viruses with dsDNA genomes
 - Caulimovirus* (type species cauliflower mosaic virus)
 - Badnavirus* (type species commelina yellow mottle virus)
 5. Viruses with ssRNA but no particles
 - Umbravirus* (type species carrot mottle virus)
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group I and *Betacryptovirus* = sub-group II) to join the 2 existing genera of fungus viruses. The remaining 22 genera are as yet not clustered into higher taxa but are presented in Table 3 under the convenient headings of particle morphology and genome structure.

The classification into families formalises unofficial usage in some instances (e.g. *Bromoviridae* has sometimes been called *Tricornaviridae*) and should have useful predictive power in that genera in a family should share some characteristics. However, for some genera (Table 3) it is not clear how clustering into families can yield discontinuous groupings to give "natural" families because the characters available at present do not discriminate clearly between groups of genera. More information may resolve these problems or it may be necessary, if higher clustering is deemed essential, to adopt an arbitrary approach.

The present scheme represents an early stage in the development of a structured classification of plant viruses. Inevitably it is incomplete. There are distinctive viruses which have not yet been assigned to genera (e.g. coconut foliar decay virus, ourmia melon virus, etc.) and some genera (e.g. *Luteovirus*) which seem to be too heterogeneous for their retention as one genus to be useful. Thus one purpose of this note is to solicit comments on the present scheme from members of the plant virology community. These should be communicated to ICTV via any member of the Plant Virus Sub-Committee.

References

- Francki RIB, Fauquet CM, Knudson DL, Brown F (eds) (1991) Classification and Nomenclature of Viruses. Fifth Report of the International Committee on Taxonomy of Viruses. Springer, Wien New York (Arch Virol [Suppl] 2)
- Martelli GP (1992) Classification and nomenclature of plant viruses: State of the art. Plant Dis 76: 436-442

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