



PERSPECTIVE

Towards a coherent nomenclature of plant viruses

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The International Committee on Taxonomy of Viruses (ICTV) has the decree to set the rules for the classification and naming of viruses. The species is the lowest level considered in the taxonomic hierarchy. In general, virus species are named according to the structure “<isolation host> <symptoms> and the word ‘virus’”. A typical example is *Tobacco mosaic virus* [Genus: *Tobamovirus*]. With a few exceptions, this convention has been generally well accepted. As there is always room for improvement, virus nomenclature (King et al., 2011) can be managed more efficiently through several ways.

The guidelines used to name plant virus species and isolates are either not defined or differ according to the specific virus considered. Specifically, this issue raises several difficulties when attempting to compare different viruses. A common reader generally becomes confused as the names vary significantly when switching from one virus group to another. Therefore, there is a need to set further guidelines to impart consistency, comprehensiveness, and clarity. For instance, viruses identified on *Abelmoschus esculentus* have been referred to as either **Bhendi yellow vein mosaic virus** [Genus: *Begomovirus*] or **Okra mosaic virus** [Genus: *Tymovirus*]. Although confusing, naming a species with common names seems to be a useful

strategy, which can facilitate pronunciation and can help to differentiate multiple species infecting the same host.

Different virologists follow different criteria to name viruses, which may contribute to the observed inconsistency and randomness, specifically with respect to the plant-host case. Some have used generic names; for instance, **Bean yellow dwarf virus** [Genus: *Mastrevirus*], **Cereal yellow dwarf virus-RPV** [Genus: *Polerovirus*], **Clover yellow vein virus** [Genus: *Potyvirus*], **Cucurbit yellow stunting disorder virus** [Genus: *Crinivirus*], **Melon necrotic spot virus** [Genus: *Carmovirus*], and **Pepper mild mottle virus** [Genus: *Tobamovirus*]. Others have used common plant names such as **Barley yellow dwarf virus-PAV** [Genus: *Luteovirus*] and **Maize chlorotic mottle virus** [Genus: *Machlomovirus*], while complete botanical names are used in other cases. For example, ***Lycopersicon esculentum* ToRTL1 virus** [Genus: *Sirevirus*], ***Nicotiana tabacum* TnT1 virus** [Genus: *Pseudovirus*], and ***Oryza sativa* endornavirus** [Genus: *Endornavirus*]. In addition, some virologists have preferred to rely on the plant-host genera to name their viruses such as **Abutilon yellows virus** [Genus: *Crinivirus*], **Basella rugose mosaic virus** [Genus: *Potyvirus*], **Cymbidium mosaic virus** [Genus: *Potexvirus*], **Duranta leaf curl aphasatellite** [subviral

agent], **Gentian mosaic virus** [Genus: *Fabavirus*], **Glycine mosaic virus** [Genus: *Comovirus*], **Lolium latent virus** [Genus: *Lolavirus*], **Rehmania mosaic virus** [Genus: *Tobamovirus*], and **Sonchus virus** [Genus: *Cytorhabdovirus*].

With respect to plant virus nomenclature, unlike in viruses infecting humans (Kuhn et al., 2013), the concept of a ‘virus’ has not been differentiated from the concept of a ‘virus-species’. Therefore, abbreviating species names in the isolate descriptions (like abbreviating a virus name) does not create a misconception. However, in some cases, it is quite difficult to differentiate an abbreviation of a plant host and the symptom displayed in a viral disease. Examples of this problem include CVCV–*Chrysanthemum vein chlorosis virus* (un-assigned member of the family *Rhabdoviridae*) and APLPV–*American plum line pattern virus* [Genus: *Illavirus*].

Different abbreviations have formally been used by different study groups, even for the same host species. For example, “Tom”, “To”, and “T” have all been used to represent tomatoes, such as **TomMMoV**–*Tomato mild mottle virus* [unassigned Genus: *Potyvirus*], **ToMV**–*Tomato mosaic virus* [Genus: *Tobamovirus*], and **TSWV**–*Tomato spotted wilt virus* [Genus: *Tospovirus*]. Similarly, soybean has been abbreviated as both “S” and “Sb”, such as **SMV**–

Soybean mosaic virus [Genus: *Potyvirus*] and **SbDV**–*Soybean dwarf virus* [Genus: *Luteovirus*].

By contrast, the same abbreviations have also been used for different plant viruses. For example, the letter “P” has frequently been used for multiple plant hosts in naming viruses (and a viroid), including: PRSV–**Papaya ringspot virus** [Genus: *Potyvirus*], PMoV–**Parietaria mottle virus** [Genus: *Ilarvirus*], PPV–**Plum pox virus** [Genus: *Potyvirus*], PVX–**Potato virus X** [Genus: *Potexvirus*], PEBV–**Pea early-browning virus** [Genus: *Tobravirus*], PVCV–**Pelargonium vein clearing virus** [Genus: *Nucleorhabdovirus*], PVYV–**Pitosporum vein yellowing virus** [Genus: *Nucleorhabdovirus*], and PLMVD–**Peach latent mosaic viroid** [Genus: *Pelamoviroid*]. Similarly, the letter “T” has been used for different hosts, including TMV–**Tobacco mosaic virus** [Genus: *Tobamovirus*] and TYLCV–**Tomato yellow leaf curl virus** [Genus: *Begomovirus*]. Furthermore, “S” has been used for SMV–**Soybean mosaic virus** [Genus: *Potyvirus*], SYN–**Sonchus yellow net virus** [Genus: *Nucleorhabdovirus*], SYVV–**Sowthistle yellow vein virus** [Genus: *Nucleorhabdovirus*], and SLCuV–**Squash leaf curl virus** [Genus: *Begomovirus*].

Such prevailing confusion that results from following multiple formats may be best resolved by basing nomenclature on the genus names of the affected plants. This may impart clarity for general understanding, at an international level, and in deciding names for newly identified viruses. For accurate communication, uniformity, clarity, and consistency in nomenclature, some general guidelines should be established and followed, such as:

1. The virus species name may strictly follow a format such as <plant-host genus> <displayed symptom> <the word ‘virus’>; a typical example of this structure is *Lolium lat-*

ent virus. Therefore, host generic names, common names, full scientific names, and geographical areas of isolation should be avoided in the species name.

2. For use in isolate description, when abbreviating the virus species name, the first two letters of the plant genus should be included; for instance, **LoLV** for *Lolium latent virus*.

3. For isolate description, use of the complete plant-host scientific names is preferable, such as *Lolium multiflorum* and *Lolium perenne*. In publications and presentations, owing to space requirements, scientific names may be abbreviated when used in phylograms, diagrams, alignments, graphs and illustrations. That is, the first letter of the genus would be followed by the full species name such as L.multiflorum and L.perenne. Even the plant-species name can be shortened as L.mul and L.per, respectively. Notably, the abbreviated versions need not be italicized.

4. To include the geographic location in descriptors, a two-letter or three-letter international code of a country or territory (<http://www.worldatlas.com/aatlas/ctycodes.htm>) may be preferred. For instance, USA.

5. The year of sampling should be written according to the Gregorian calendar, following a 4-digit or 2-digit format; for instance, 2000.

6. Virus isolates may be named according to a single format with defined acronyms/features, such as species name followed by isolate descriptors–host, isolation year, and area, etc. That is, ‘<abbreviated virus-species name>-<strain name if exists>[<isolate identifier>-<genus of the isolation host>-<sampling year>-<country>] accession number’. The full isolate description may thus be given as: **LoLV**-[US1-L.per x L.mul MF22-2000-USA] EU489641.

To this end, to name a virus species, the use of the host-genus name appears to be the most appropriate. However, this may create potential

problems as well. For instance, it seems absurd at this point to change the name of **Tobacco mosaic virus** (TMV) to **Nicotiana mosaic virus** (NiMV) given that the term TMV has been used in the literature for more than a century and is well-established. Furthermore, the new term NiMV is a completely unusual format. The dispute may be settled if the new guide-lines are followed only for newly reported viruses allowing for previously named viruses to be retained as per convention.

Such uniform attributes in plant virus nomenclature, if applied consistently, would simplify the retrieval of sequences from electronic repositories. This is also expected to increase the general understanding of publications, presentations, phylograms, alignments, and diagrams relating to plant viruses. Furthermore, it will counteract the increasing confusion caused by the use of acronyms for the ever-growing number of newly identified sequences owing to breakthroughs in high-throughput sequencing technology.

FOOTNOTES

This article does not contain any studies with human or animal subjects performed by the author.

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