

**Part 1:** **TITLE, AUTHORS, APPROVALS, etc**

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| **Code assigned:** | **2021.016P** |  |
| **Short title:** Create eleven new species in the family (*Pospiviroidae*) | | |
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| Francesco Di Serio |

**List the ICTV Study Group(s) that have seen this proposal**

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| ICTV *Avsunviroidae* and *Pospiviroidae* Study Group |

**ICTV study group comments and response of proposer**

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**Authority to use the name of a living person**

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| **Is any taxon name used here derived from that of a living person (Y/N)** | N |

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| **Taxon name** | **Person from whom the name is derived** | **Permission attached (Y/N)** |
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**Submission dates**

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| Date first submitted to SC Chair | May 26, 2021 |
| Date of this revision (if different to above) | September 14, 2021 |

**ICTV-EC comments and response of the proposer**

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| The new species *Coleus brumei viroid-5* and *Coleus brumei viroid-6* may result from recombination events within two members of current viroid species. However, the autonomous replication capability, the maintenance of the inoculated viroid in the progeny and biological activity have been demonstrated (Jiang et al. 2014), thus supporting the creation of two new viroid species. The text has been modified accordingly. |

**Part 3:** **TAXONOMIC PROPOSAL**

**Name of accompanying Excel module**

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| 2021.016P.R.Pospiviroidae\_11ns |

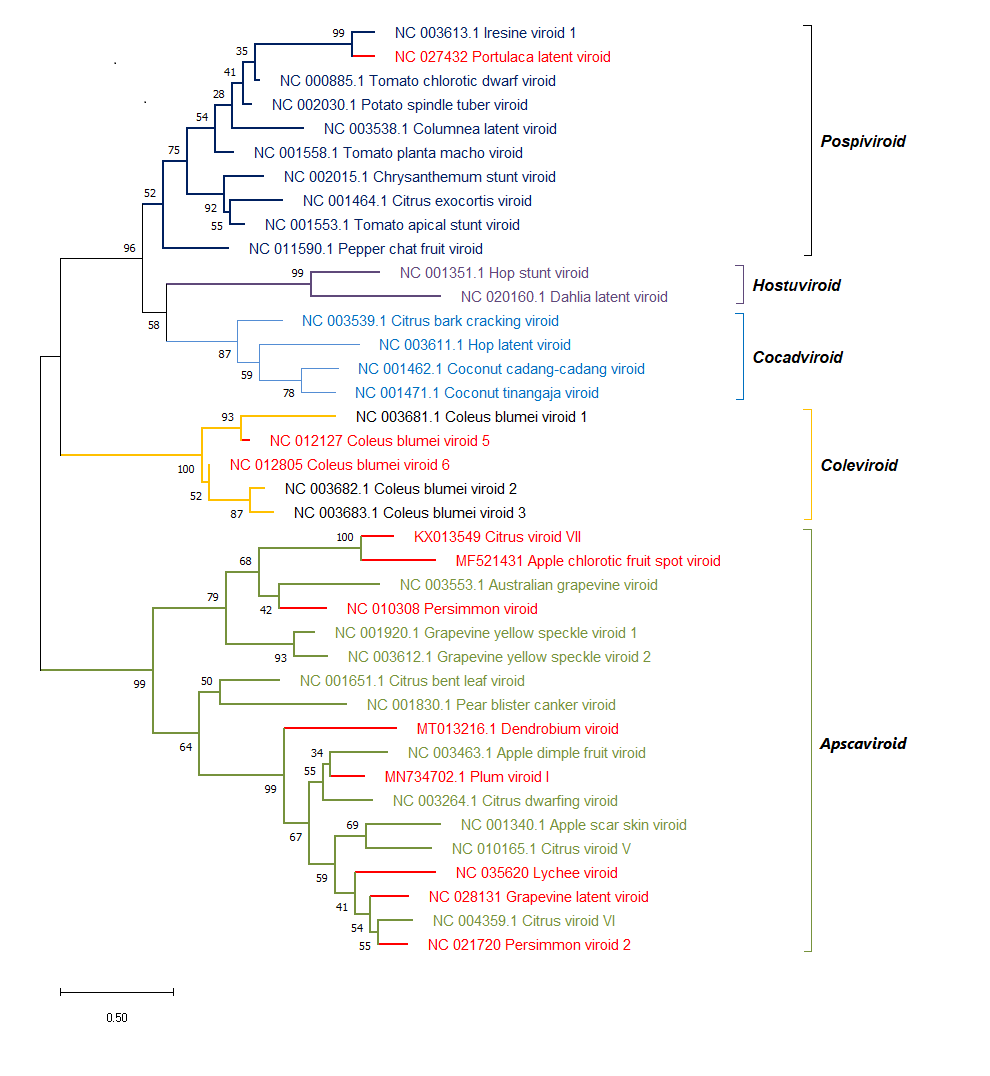
**Abstract**

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| New species demarcation criteria have been proposed by the ICTV *Avsunviroidae* and *Pospiviroidae* Study Group in an associated taxonomic proposal (2021.015P). According with these criteria, the ICTV *Avsunviroidae* and *Pospiviroidae* Study Group here proposes the creation of eight new species in the genus *Apscaviroid,* two new species in the genus *Coleviroid,* one new species in the genus *Pospiviroid.* Evaluation of this proposal is subordinated to the acceptance of the associated proposal (2021.015P). |

**Text of proposal**

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According with proposal 2021.015P the species demarcation criteria for the members of each genus of family *Pospiviroidae* are as follows:  **Family *Pospiviroidae*:**  Genus *Apscaviroid*:  Viroids with rod-like or quasi rod-like conformation, with the TCR, a CCR identical to that of members of the other species of the genus and less than 78% pairwise sequence identity with respect to the members of the genus are classified in different species. For viroids with pairwise identity scores close to 78%, evidence of distinct biological properties should be provided.  Genus *Cocadviroid*:  Viroids with rod-like conformation, with the TCH, a CCR identical to that of members of the species in the genus and less than 79% pairwise sequence identity with respect to the other members of the genus, are classified in different species. For viroids with pairwise identity scores close to 79%, evidence of distinct biological properties should be provided.  Genus *Coleviroid*:  Viroids with a rod-like conformation, with the TCR with the CCR identical to that of members of the other species of the genus and less than 91% pairwise sequence identity with respect to the other members of the genus are classified in different species. A TCH can be present instead of a TCR in the viroids with the smallest genome. For viroids with pairwise identity scores close to 91%, evidence of distinct biological properties should be provided.  Genus *Hostuviroid*:  Viroids with a rod-like conformation, with the TCH (or with the TCR instead of the TCH), with the CCR identical to that of members of the other species of the genus and less than 79% pairwise sequence identity with respect to the other members of the genus are classified in different species. For viroids with pairwise identity scores close to 79%, evidence of distinct biological properties should be provided.  Genus *Pospiviroid*:  Viroids with a rod-like conformation, with the TCH, with the CCR identical to that of members of the other species of the genus and less than 83% pairwise sequence identity with respect to the other members of the genus, should be classified in different species. For viroids with pairwise identity scores close to 83%, evidence of distinct biological properties should be provided.  According with the proposed criteria, when it must be established whether a viroid is a representative member of a new or an existing species of a certain genus, a pairwise identity matrix is calculated using the sequences of the viroids already classified in that genus and those of the novel viroid. If in such a matrix, the maximum PWIS associated with the sequences of the novel viroid is below the TIS, the novel viroid should be classified in a new species. Anyway, for a conclusive classification, it is mandatory to show the autonomous replication capability of viroids resulting from recombination events. For instance, in the case of Coleus brumei viroid-5 and -6, the autonomous replication, the maintenance of the inoculated viroid in the progeny and the biological activity have been shown (Jiang et al. 2014).  Table 1 lists several viroids that have been reported in the literature, since several years or more recently, but have not classified yet. For all these viroids, the complete genome has been sequenced and several sequence variants have been identified and annotated in databases. Based on their structural features, and in particular the rod-like or quasi-rod-like conformation, the type of CCR and the presence/absence of TCR and TCH, these viroids fulfil the criteria to be recognized as members of a current genus of the family *Pospiviroidae* (Table 1) (Di Serio et al. 2021; Chiumenti et al. 2021). However, they were not conclusively classified because of uncertainties regarding the fulfilment of one of the current species demarcation criteria demanding for evidence of biological divergence between the novel viroids and the members classified in the closest related species.  **Table 1.** List of viroids not classified yet   |  |  |  | | --- | --- | --- | | **Genus** | **Viroid names** | **References** | | ***Apscaviroid*** | apple chlorotic fruit spot viroid | Leichtfried et al. 2019 | | citrus viroid VII | Chambers et al. 2018 | | dendrobium viroid | Yang et al. 2020 | | grapevine latent viroid | Zhang et al. 2014 | | lychee viroid | Jiang et al. 2017 | | persimmon viroid | Nakaune and Nakano 2008 | | persimmon viroid 2 | Ito et al. 2013; Bester et al. 2020 | | plum viroid I | Bester et al. 2020 | | ***Coleviroid*** | Coleus blumei viroid 5 | Hou et al. 2009a; Jiang et al. 2014 | | Coleus blumei viroid 6 | Hou et al. 2009b; Jiang et al. 2014 | | ***Pospiviroid*** | portulaca latent viroid | Verhoeven et al. 2015 |   In the case of all the viroids reported in Table 1, Chiumenti et al. (2021) calculated the pairwise identity matrices considering all the sequence variants of the viroids already classified in the genus in which they were tentatively classified. The maximum PWISs associated to each viroid in the matrices and the TIS of the respective genus are reported in Table 2.  **Table 2**. Maximum pairwise identity score (PWIS) calculated for each viroid by considering all the variants in their pertinent genus. The proposed thresholds identity score (TIS) for each genus and the abbreviations of the viroid names are also indicated.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Genus** | **Viroid names** | **Abbreviation** | **Maximum PWIS considering all variants in the genus** | **TIS (%)** | | ***Apscaviroid*** | apple chlorotic fruit spot viroid | ACFSVd | 55,5 | 78 | | citrus viroid VII | CVd-VII | 55,6 | | dendrobium viroid | DVd | 47,2 | | grapevine latent viroid | GLVd | 69,9 | | lychee viroid | LVd | 52,7 | | persimmon viroid | PVd | 44,7 | | persimmon viroid 2 | PVd-2 | 34,5 | | plum viroid I | PlVd-I | 52,7 | | ***Coleviroid*** | Coleus blumei viroid 5 | CbVd-5 | 58,6 | 91 | | Coleus blumei viroid 6 | CbVd-6 | 76 | | ***Pospiviroid*** | portulaca latent viroid | PLVd | 61,3 | 83 |   Being the pairwise identity scores for each viroid listed in Table 2 quite below the TIS of the pertinent genus (Table 2), these viroids fulfil the novel species demarcation criteria reported above. Therefore, should the species demarcation criteria reported in the associated proposal 2021.015P be approved by ICTV, we propose that:   1. apple chlorotic fruit spot viroid (ACLSVd) is classified in the novel species *Apscaviroid* *aclsvd* of the genus *Apscaviroid;* the proposed binomial name of the species is composed of the name of the genus and the abbreviation of the viroid name used as species epithet*;* 2. citrus viroid VII (CVd-VII) is classified in the novel species *Apscaviroid cvd-VII* of the genus *Apscaviroid;* the proposed binomial name of the species is composed of the name of the genus and the abbreviation of the viroid name used as species epithet*;* 3. dendrobium viroid (DVd) is classified in the novel species *Apscaviroid dvd* of the genus *Apscaviroid;* the proposed binomial name of the species is composed of the name of the genus and the abbreviation of the viroid name used as species epithet*;* 4. grapevine latent viroid (GLVd) is classified in the novel species *Apscaviroid glvd* of the genus *Apscaviroid;* the proposed binomial name of the species is composed of the name of the genus and the abbreviation of the viroid name used as species epithet*;* 5. lychee viroid (LVd) is classified in the novel species *Apscaviroid lvd* of the genus *Apscaviroid;* the proposed binomial name of the species is composed of the name of the genus and the abbreviation of the viroid name used as species epithet*;* 6. persimmon viroid (PVd) is classified in the novel species *Apscaviroid pvd* of the genus *Apscaviroid¸* the proposed binomial name of the species is composed of the name of the genus and the abbreviation of the viroid name used as species epithet*;* 7. persimmon viroid (PVd-2) is classified in the novel species *Apscaviroid pvd-2* of the genus *Apscaviroid¸* the proposed binomial name of the species is composed of the name of the genus and the abbreviation of the viroid name used as species epithet*;* 8. plum viroid I (PlVd-1) is classified in the novel species *Apscaviroid plvd-I* of the genus *Apscaviroid;* the proposed binomial name of the species is composed of the name of the genus and the abbreviation of the viroid name used as species epithet; 9. Coleus blumei viroid 5 (CbVd-5) is classified in the novel species *Coleviroid cbvd-5* of the genus *Coleviroid;* the proposed binomial name of the species is composed of the name of the genus and the abbreviation of the viroid name used as species epithet; 10. Coleus blumei viroid 6 (CbVd-6) is classified in the novel species *Coleviroid cbvd-6* of the genus *Coleviroid;* the proposed binomial name of the species is composed of the name of the genus and the abbreviation of the viroid name used as species epithet; 11. portulaca viroid (PLVd) is classified in the novel species *Pospiviroids plvd* of the genus *Pospiviroid;* the proposed binomial name of the species is composed of the name of the genus and the abbreviation of the viroid name used as species epithet;   The classification of the members of 11 novel proposed species in the respective genera is also supported by phylogenetic relationships with the other viroids, as shown by the maximum likelihood phylogenetic tree inferred with the reference viroid variants of the proposed new viroid species and those of the species currently classified by ICTV in the five genera of the family *Pospiviroidae* (Figure 1). | |

**Supporting evidence**

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**Figure 1.** Maximum likelihood phylogenetic tree inferred with the reference variants of the species currently classified by ICTV in the five genera of the family *Pospiviroidae* and of the viroids yet unclassified (in red). Bootstrap values (generated by 1,000 replicates) are shown next to the branches. The tree is drawn to scale, with branch lengths measured in the number of substitutions per site.

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