



ICTV Virus Taxonomy Profile: *Hypoviridae* 2023

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Abstract

Hypoviridae is a family of capsidless viruses with positive-sense RNA genomes of 7.3–18.3 kb that possess either a single large open reading frame (ORF) or two ORFs. The ORFs appear to be translated from genomic RNA by non-canonical mechanisms, i.e. internal ribosome entry site- and stop/restart translation. This family includes the genera *Alphahypovirus*, *Betahypovirus*, *Gam mahypovirus*, *Deltahypovirus*, *Epsilonhypovirus*, *Zetahypovirus*, *Thetahypovirus* and *Etahypovirus*. Hypovirids have been detected in ascomycetous and basidiomycetous filamentous fungi and are considered to replicate in host, Golgi apparatus-derived, lipid vesicles that contain virus dsRNA as the replicative form. Some hypovirids induce hypovirulence to host fungi, while others do not. This is a summary of the ICTV report on the family *Hypoviridae*, which is available at www.ictv.global/report/hypoviridae.

Table 1. Characteristics of members of the family *Hypoviridae*

Example:	Cryphonectria hypovirus 1 strain EP713 (M57938), species <i>Alphahypovirus cryphonectriae</i> , genus <i>Alphahypovirus</i>
Virion	Capsidless (no true virions)
Genome	7.3–18.3 kb of linear, positive-sense, unsegmented RNA
Replication	Replication and transcription occur cytoplasmically, and for <i>Cryphonectria hypovirus 1</i> in Golgi apparatus-derived membranous vesicles
Translation	Directly from genomic RNA containing a possible internal ribosomal entry site at the 5'-non-coding region. <i>Cryphonectria hypovirus 1</i> ORF B is translated through re-initiation after the ORF A stop codon
Host range	Fungi; viruses identified in animals (arthropods) need confirmatory evidence
Taxonomy	Realm <i>Riboviria</i> , kingdom <i>Orthornavirae</i> , phylum <i>Pisuviricota</i> , class <i>Duploviricetes</i> , order <i>Durnavirales</i> ; >7 genera and >35 species

VIRION

No true virions are associated with members of the family *Hypoviridae*. Pleomorphic vesicles 50–80 nm in diameter [1], devoid of any detectable viral structural proteins but containing replicative form dsRNA and polymerase activity [2], are the only virus-associated structures that can be isolated from infected fungal tissue (Table 1); isolated vesicles co-purify with trans-Golgi apparatus markers [3].

GENOME

Hypovirus genomes range from 7.3 to 18.3 kb excluding a 3'-poly(A) tail of 20–30 nt, and possess one or two ORFs (Fig. 1) [4] flanked by relatively long 5'- and 3'-terminal non-coding regions (NCRs). Translational initiation for the first ORF on the genomic RNA is mediated by an internal ribosome entry site in the 5'-NCR extending to the coding domain in the case of *Cryphonectria hypovirus 1*. For hypovirids with

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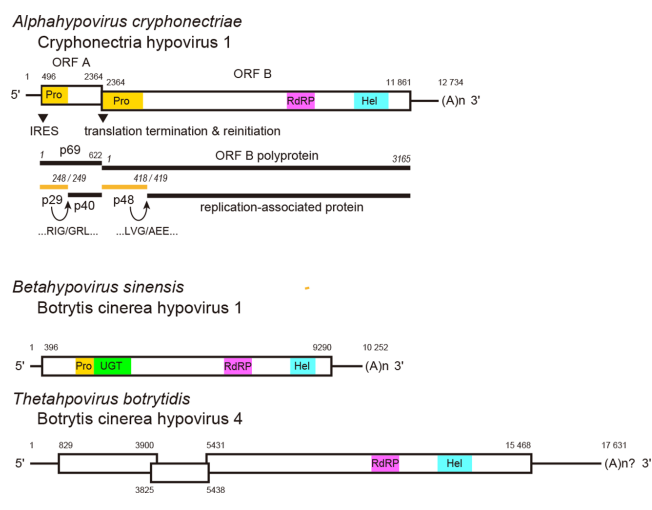


Fig. 1. Genome organization of representative members of the family *Hypoviridae*. Arrows represent known sites of autoproteolysis. The abbreviations RdRP, Hel and UGT refer to the RNA-directed RNA polymerase, RNA helicase and UDP-glucose/sterol glucosyltransferase domains, respectively. IRES, internal ribosomal entry site; Pro, protease.

a two ORF genome organization, a stop/restart mechanism is involved in the translation of the downstream ORF in which the pentanucleotide UAAUG, plays a critical role [5]. Many hypovirids have shorter-than-full-length, internally-deleted, defective interfering and defective replicative form dsRNA molecules; others have replicative forms of satellite-like RNAs [6, 7]. The host RNA silencing pathway has been reported to promote defective interfering RNA production [8]. No function has been ascribed to any ancillary RNA.

REPLICATION

Positive- and negative-sense viral RNA synthesis is believed to occur cytoplasmically in host-derived lipid vesicles that contain linear dsRNA. The polymerase associated with

vesicles transcribes ssRNA molecules *in vitro* that correspond in size to full-length dsRNA. Approximately 80% of the polymerase products *in vitro* are of positive-sense. Except for the p50 of *Cryphonectria hypovirus 2*, hypovirid proteins are synthesized as part of a polyprotein that is autocatalytically cleaved by viral proteases such as p29 and p48 (*Cryphonectria hypovirus 1*) and p52 (*Cryphonectria hypovirus 2*). Smaller proteins encoded by the 3'-proximal ORF of *Cryphonectria hypovirus 1* have been identified in the vesicle-associated polymerase complex, suggesting extensive processing of the ORF B-encoded polyprotein *in vivo* by unknown viral or host proteases [2]. *Cryphonectria hypovirus 1* p29 enhances virus replication *in cis* and *in trans*, possibly by suppressing antiviral RNA silencing [8]. The p48 protein encoded by *Cryphonectria hypovirus 1* ORF B is required for initiation, but not maintenance of viral RNA replication [9].

TAXONOMY

Current taxonomy: ictv.global/taxonomy. The family *Hypoviridae* includes the genera *Alphahypovirus*, *Betahypovirus*, *Gammahypovirus*, *Deltahypovirus*, *Epsilonhypovirus*, *Zetahypovirus*, *Thetahypovirus* and *Etahypovirus*.

RESOURCES

Full ICTV Report on the family *Hypoviridae*: www.ictv.global/report/hypoviridae.

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Conflicts of interest

The authors declare that there are no conflicts of interest.

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