

Israeli Acute Paralysis Virus

Comprehensive Findings Review

Synthesised from the abstracts and full texts of the most-cited and representative papers within a harvested corpus of 871 records (743 open access). A curated review of landmark findings, not an exhaustive catalogue. Generated 2026-06-12.

Executive Summary

Israeli acute paralysis virus (IAPV) is a positive-sense, single-stranded RNA virus of the family **Dicistroviridae**, first isolated from honey bees in Israel in 2007. It belongs to the **ABPV-KBV-IAPV (AKI) complex** of closely related, frequently recombining viruses. IAPV is best known for the 2007 metagenomic survey that found it strongly correlated with Colony Collapse Disorder (CCD) in the United States — a correlation, never a proven cause, but one that thrust bee viruses into global attention (Cox-Foster 2007). Like its AKI relatives, IAPV is usually a covert, sub-clinical infection that becomes acutely lethal at high titre, causing paralysis, trembling, darkening and rapid death — typically when amplified and vectored by the mite *Varroa destructor*. IAPV became a flagship target for RNA-interference (RNAi) therapeutics, including the first large-scale field trial of RNAi for any disease. This document synthesises the findings by theme and catalogues the landmark studies.

Family	Dicistroviridae; positive-sense ssRNA ~9.5 kb (Maori 2007)
Genome	Dicistronic: ORF1 (non-structural) + ORF2 (capsid) separated by an intergenic-region IRES; 5' IRES
Complex	Member of the ABPV-KBV-IAPV (AKI) complex; extensive recombination & DI-like RNAs (Maori 2007; de Miranda 2010)
Discovery	Isolated from dead bees in Israel, 2007 (Maori 2007)
Notoriety	Strongly correlated with Colony Collapse Disorder in the 2007 US metagenomic survey (Cox-Foster 2007)
Vector	<i>Varroa destructor</i> — replication-competent, effective vector (Di Prisco 2011)
Pathology	Covert at low titre; acute paralysis, trembling, darkening, death at high titre
Control	Flagship RNAi target; first large-scale field RNAi trial (Hunter 2010; Maori 2009)

Discovery and the Colony Collapse Disorder Association

IAPV was isolated, sequenced and characterised from dead honey bees in Israel and described as a distinct dicistrovirus most closely related to Kashmir bee virus and acute bee paralysis virus (Maori 2007). It rose to prominence the same year, when an unbiased metagenomic survey of CCD-affected versus healthy US colonies found IAPV strongly correlated with CCD — the single organism most associated with the disorder (Cox-Foster 2007). It is essential to be precise about this: the finding was a **correlation, not a demonstrated cause**. Subsequent studies failed to find IAPV in all CCD-diagnosed colonies, although IAPV was confirmed to cause honey bee mortality in its own right (Hunter 2010). The episode nonetheless made IAPV one of the most studied and politically visible bee viruses.

Taxonomy, Genome and the AKI Complex

IAPV is one of three closely related members of the **ABPV-KBV-IAPV (AKI) complex** within the family Dicistroviridae — a group with widespread prevalence in honey bee colonies and a predominantly sub-clinical etiology that contrasts sharply with extreme virulence at high titre (de Miranda 2010). The genome is a positive-sense RNA of ~9,487 nucleotides with two open reading frames separated by an intergenic region; the non-structural proteins are encoded by the first ORF and the four major capsid proteins by the second (Maori 2007). IAPV is genetically variable: virions

carry shorter defective-interfering (DI)-like RNAs, and recombination occurs both within IAPV and between IAPV and other dicistroviruses, and even with non-viral (host) RNA — IAPV sequences have been found integrated into the host genome (Maori 2007). This standing genetic variation may underlie the differing pathology of IAPV strains worldwide (Chen 2014).

Pathology, Host Response and Immune Subversion

At low titre IAPV persists as a covert infection; at high titre it causes acute disease — paralysis, trembling, darkening and rapid death. IAPV is established as a persistent infection in honey bee populations, maintained by both horizontal and vertical transmission (Chen 2014). Transcriptomic profiling shows that infection most significantly disturbs mitochondrial function, implying disruption of host energy metabolism, while also triggering active immune responses in adult bees (Chen 2014). Critically, IAPV encodes a putative **suppressor of RNAi** — a mechanism to subvert the bee's principal antiviral defence — and silencing this region reduces IAPV replication, a finding that doubles as a therapeutic strategy (Chen 2014).

Transmission and the Varroa Connection

IAPV spreads by multiple routes. It is transmitted horizontally and vertically and was among the picorna-like viruses detected in pollen pellets, with virus-contaminated food shown to be infective (Singh 2010; Chen 2014). The mite *Varroa destructor* is an effective biological vector: it is IAPV replication-competent, and bees become infected after exposure to virus-carrying mites, with IAPV copy number positively correlated with mite density and exposure time (Di Prisco 2011). The mite-virus association can also suppress host immunity, promoting elevated viral replication (Di Prisco 2011). As with the rest of the AKI complex, *Varroa* acts both to disseminate the virus and to activate its multiplication within bees and larvae (Genersch 2010).

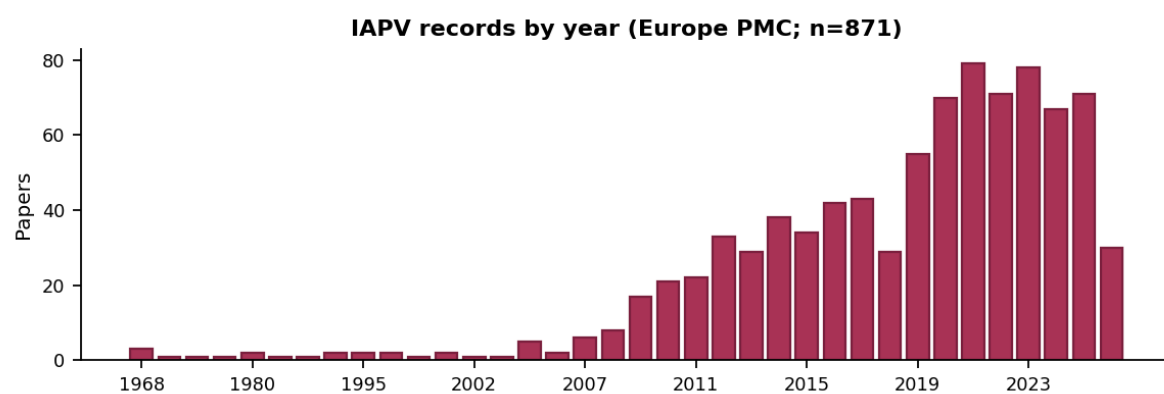
RNA Interference: From Therapy to Field Trial

IAPV became the flagship target for RNAi-based bee-virus control. Feeding bees double-stranded RNA specific to IAPV silenced the infection and protected against it under laboratory conditions (Maori 2009). This was scaled up into what was, to the authors' knowledge, the first successful large-scale, real-world field application of RNAi for disease control — 160 hives across Florida and Pennsylvania, with IAPV-specific dsRNA reducing mortality and improving bee health (Hunter 2010). Because IAPV encodes an RNAi suppressor, silencing that suppressor offers a route to limit multiple dicistroviruses simultaneously (Chen 2014). This body of work underpinned commercial efforts toward RNAi bee therapeutics.

Host Range, Spillover and Distribution

Although a honey bee virus, IAPV is part of the shared pollinator virome. It was detected in non-Apis hymenopterans and in pollen, indicating potential for inter-taxa transmission (Singh 2010), and honey-bee RNA viruses generally are widespread in sympatric wild bumblebees, with prevalence in honey bees predicting prevalence in bumblebees (McMahon 2015; Fürst 2014). IAPV has a broadly global but geographically variable distribution, with strain-level differences in prevalence and pathology (Chen 2014; de Miranda 2010).

Research Activity



Landmark Study Catalogue

Selected by citation impact and thematic importance. Core studies:

Cox-Foster 2007 — A metagenomic survey of microbes in honey bee colony collapse disorder (2007, *Science*; cited 1008)

Unbiased metagenomic survey of CCD, healthy hives and royal jelly to find candidate pathogens.

- Of all organisms screened, Israeli acute paralysis virus was the one strongly correlated with CCD.
- Correlation was established across samples from several sites over three years.
- Irradiated combs from affected colonies could be repopulated, suggesting an infectious contribution to CCD.
- The study established IAPV as a marker — not a proven cause — of CCD.

None · doi:10.1126/science.1146498

Maori 2007 — Isolation and characterization of Israeli acute paralysis virus, a dicistrovirus affecting honeybees (2007, *J. General Virology*; cited 157)

Isolated, sequenced and characterised IAPV from dead Israeli bees.

- IAPV is a distinct dicistrovirus, most homologous to Kashmir bee virus and acute bee paralysis virus.
- Genome is 9,487 nt, positive-sense, with two ORFs separated by an intergenic region; capsid has four major proteins.
- Virions carry defective-interfering (DI)-like RNAs.
- Found extensive recombination within IAPV, between IAPV and other dicistroviruses, and with non-viral RNA — including integration of IAPV sequences into the host genome.

None · doi:10.1099/vir.0.83284-0

de Miranda 2010 — The Acute bee paralysis virus-Kashmir bee virus-Israeli acute paralysis virus complex (review) (2010, *J. Invertebrate Pathology*; cited 191)

Comprehensive review of the AKI dicistrovirus complex.

- ABPV, KBV and IAPV form a complex of closely related Dicistroviridae with widespread prevalence.
- Predominantly sub-clinical etiology contrasting with extreme virulence at elevated titres.
- Frequently implicated in colony losses, especially under *Varroa destructor* infestation.
- Reviewed IAPV's CCD association, siRNA treatment, and possible honey bee resistance to IAPV.

None · doi:10.1016/j.jip.2009.06.014

Chen 2014 — Israeli acute paralysis virus: epidemiology, pathogenesis and implications for honey bee health (2014, *PLoS Pathogens*; cited 136)

Characterised IAPV transmission, prevalence, genetics and host responses.

- IAPV is a persistent infection maintained by both horizontal and vertical transmission.
- Strain pathology differences may stem from high standing genetic variation.
- Microarrays showed mitochondrial function is the most disrupted host process; immune pathways are activated.
- Silencing an IAPV-encoded putative RNAi suppressor reduced replication — a therapeutic strategy against multiple dicistroviruses.

PMC4117608 · doi:10.1371/journal.ppat.1004261

Di Prisco 2011 — Varroa destructor is an effective vector of Israeli acute paralysis virus (2011, J. General Virology; cited 149)

Tested whether Varroa replicates and vectors IAPV.

- First evidence that Varroa destructor is IAPV replication-competent and vectors it to bees.
- Bees became infected after exposure to IAPV-carrying mites.
- IAPV copy number was positively correlated with mite density and exposure time.
- The mite-virus association may reduce host immunity and promote elevated replication.

None · doi:10.1099/vir.0.023853-0

Maori 2009 — IAPV, a bee-affecting virus associated with CCD, can be silenced by dsRNA ingestion (2009, Insect Molecular Biology; cited 172)

Tested RNAi silencing of IAPV by feeding bees dsRNA.

- Feeding bees IAPV-specific double-stranded RNA silenced the infection.
- Demonstrated RNAi as an efficient, feasible route to control IAPV disease.
- Framed RNAi feeding as a practical approach to mitigating CCD-associated viral disease.

None · doi:10.1111/j.1365-2583.2009.00847.x

Hunter 2010 — Large-scale field application of RNAi technology reducing IAPV disease in honey bees (2010, PLoS Pathogens; cited 140)

Field-tested IAPV-specific dsRNA across 160 hives in two US states.

- IAPV-specific dsRNA reduced mortality and improved health of IAPV-infected bees in the field.
- Trial spanned 160 hives across two climates/seasons (Florida and Pennsylvania).
- To the authors' knowledge, the first successful large-scale real-world use of RNAi for disease control.
- Noted IAPV causes bee mortality even though it is not present in all CCD colonies.

PMC3009593 · doi:10.1371/journal.ppat.1001160

Supporting studies:

Genersch 2010 — Emerging and re-emerging viruses of the honey bee (review) (2010, Veterinary Research; cited 164)

Reviewed how Varroa elevated the virulence of previously harmless bee viruses.

- The Dicistroviridae (ABPV, KBV, IAPV) acquired virulence in Europe/USA in relation to Varroa destructor.
- Varroa acts as a disseminator of these viruses and an activator of viral multiplication in larvae and adults.
- Control options (tolerant bees, RNAi, biosecurity) are unlikely to improve bee health short-term.

PMC2883145 · doi:10.1051/vetres/2010027

Singh 2010 — RNA viruses in hymenopteran pollinators: inter-taxa transmission via pollen (2010, PLoS ONE; cited 283)

Surveyed viruses in bees, pollen and non-Apis pollinators.

- Detected picorna-like viruses in pollen pellets; virus-contaminated food was infective.
- Bee viruses including those of the AKI group detected across multiple non-Apis hymenopteran species.
- Supports pollen/food-borne and inter-species transmission relevant to IAPV epidemiology.

PMC3008715 · doi:10.1371/journal.pone.0014357

Fürst 2014 — Disease associations between honeybees and bumblebees as a threat to wild pollinators (2014, *Nature*; cited 411)

Infection experiments + field data on honey-bee-virus spillover to bumblebees.

- Honey bee emerging viruses are widespread infectious agents across the pollinator assemblage.
- Establishes the framework of managed-bee-to-wild-pollinator spillover relevant to all shared viruses incl. IAPV.

PMC3985068 · doi:10.1038/nature12977

McMahon 2015 — A sting in the spit: widespread cross-infection of RNA viruses across wild and managed bees (2015, *J. Animal Ecology*; cited 209)

National survey of RNA-virus prevalence in honey bees and bumblebees.

- Multiple honey bee RNA viruses are widespread in sympatric wild bumblebees.
- Honey bee virus prevalence predicts bumblebee prevalence — cross-species disease pressure.

PMC4832299 · doi:10.1111/1365-2656.12345

Scope note: studies excluded as off-topic

- **Fisher 2012 / Ding 2007 / Zhu 2020 / Scott 2013 / Perrimon 2010 / Palli 2014:** General fungal-disease or RNAi-methodology reviews surfaced via shared methods; no IAPV-specific findings.
- **Katzourakis 2010 / Belyi 2010 / Atkins 2016:** Endogenous viral elements / ribosomal frameshifting — general virology that cites dicistrovirus biology but is not about IAPV.
- **Mullin 2010 / Vanengelsdorp 2009 / Cornman 2012 / Hristov 2020:** Pesticide-residue and CCD descriptive studies — IAPV is one of many factors, not the focus.
- **Ge 2012 / Nakamura 2009 / Cosar 2022 / Colby 1983 / Graf 1978 / Chen PS 2010:** Bat/SARS-CoV-2/avian-leukemia/influenza virology unrelated to bees (matched via method or 'virus' keyword).

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complex.