



Digital supplementary material to

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Viruses and their effects in ants (Hymenoptera: Formicidae). – Myrmecological
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The content of this digital supplementary material was subject to the same scientific editorial processing as the article it accompanies. However, the authors are responsible for copyediting and layout.

Tab. S1: Full list of unique viruses reported in ants; please see separately uploaded .csv file.

Our literature review of publications reporting viruses in ants showed 87 different viruses across 38 ant species. Viral genome types include: positive-sense single-stranded RNA (+ssRNA); negative-sense single-stranded RNA (-ssRNA), double-stranded RNA (dsRNA); and double-stranded DNA (dsDNA). The reported detection and sequencing methods used for each virus is summarised in the table as PCR (Polymerase Chain Reaction), Sanger (Sanger Sequencing), High-throughput sequencing; and/or Rapid amplification of cDNA ends (RACE). Reported replication refers to the viruses that have been shown to replicate in ants. References are provided for more detailed information on each virus and their discovery in ants.

References for Table S1

- Abril, S. & Jurvansuu, J. 2020: Season- and caste-specific variation in RNA viruses in the invasive Argentine ant European supercolony. – *Journal of General Virology* 101: 322-333.
- Allen, C., Valles, S.M. & Strong, C.A. 2011: Multiple virus infections occur in individual polygyne and monogyne *Solenopsis invicta* ants. – *Journal of Invertebrate Pathology* 107: 107-111.
- Brettell, L.E., Mordecai, G.J., Pachori, P. & Martin, S.J. 2017: Novel RNA virus genome discovered in ghost ants (*Tapinoma melanocephalum*) from Hawaii. – *Genome Announcements* 5: e00669-00617.
- Brettell, L.E., Schroeder, D.C. & Martin, S.J. 2019: RNAseq analysis reveals virus diversity within Hawaiian apiary insect communities. – *Viruses* 11.
- Brown, K., Olendraite, I., Valles, S.M., Firth, A.E., Chen, Y., Guérin, D.M.A., Hashimoto, Y., Herrero, S., de Miranda, J.R. & Ryabov, E.V. 2019: ICTV Virus Taxonomy Profile: Solinviviridae. – *Journal of General Virology* 100: 736-737.
- Celle, O., Blanchard, P., Olivier, V., Schurr, F., Cougoule, N., Faucon, J.-P. & Ribière, M. 2008: Detection of Chronic bee paralysis virus (CBPV) genome and its replicative RNA form in various hosts and possible ways of spread. – *Virus Research* 133: 280-284.
- Cooling, M., Gruber, M.A.M., Hoffmann, B.D., Sébastien, A. & Lester, P.J. 2016: A metatranscriptomic survey of the invasive yellow crazy ant, *Anoplolepis gracilipes*, identifies several potential viral and bacterial pathogens and mutualists. – *Insectes Sociaux* 64: 197-207.
- Deslippe, R.J. & Melvin, W.D. 2001: Assessment of ant foraging on beehives in an apiary infested with *Solenopsis invicta* (Hymenoptera: Formicidae). – *Southwestern Entomologist* 26: 215-219.
- Dhaygude, K., Johansson, H., Kulmuni, J. & Sundstrom, L. 2019: Genome organization and molecular characterization of the three *Formica exsecta* viruses-FeV1, FeV2 and FeV4. – *PeerJ* 6: e6216.
- Dobelmann, J., Felden, A. & Lester, P.J. 2020: Genetic strain diversity of multi-host RNA viruses that infect a wide range of pollinators and associates is shaped by geographic origins. – *Viruses* 12: 358.
- Fukasawa, F., Hirai, M., Takaki, Y., Shimane, Y., Thomas, C.E., Urayama, S.I., Nunoura, T. & Koyama, S. 2020: A new polycipivirus identified in *Colobopsis shohki*. – *Archives of Virology* 165: 761-763.
- Gruber, M.A.M., Cooling, M., Baty, J.W., Buckley, K., Friedlander, A., Quinn, O., Russell, J., Sebastien, A. & Lester, P.J. 2017: Single-stranded RNA viruses infecting the invasive Argentine ant, *Linepithema humile*. – *Scientific Reports* 7: 3304.
- Hashimoto, Y. & Valles, S.M. 2008: Detection and quantitation of *Solenopsis invicta* virus-2 genomic and intermediary replicating viral RNA in fire ant workers and larvae. – *Journal of Invertebrate Pathology* 98: 243-245.
- Hashimoto, Y., Valles, S.M. & Strong, C.A. 2007: Detection and quantitation of *Solenopsis invicta* virus in fire ants by real-time PCR. – *Journal of Virological Methods* 140: 132-139.
- Hsu, H.W., Chiu, M.C., Lee, C.C., Lee, C.Y. & Yang, C.S. 2019: The association between virus prevalence and intercolonial aggression levels in the yellow crazy ant, *Anoplolepis Gracilipes* (Jerdon). – *Insects* 10.
- Hsu, H.W., Chiu, M.C., Shoemaker, D. & Yang, C.S. 2018: Viral infections in fire ants lead to reduced foraging activity and dietary changes. – *Scientific Reports* 8: 13498.

Kleanthous, E., Olendraite, I., Lukhovitskaya, N.I. & Firth, A.E. 2019: Discovery of three RNA viruses using ant transcriptomic datasets. – *Archives of Virology* 164: 643-647.

Koyama, S., Sakai, C., Thomas, C.E., Nunoura, T. & Urayama, S. 2016: A new member of the family Totiviridae associated with arboreal ants (*Camponotus nipponicus*). – *Archives of Virology* 161: 2043-2045.

Koyama, S., Urayama, S., Ohmatsu, T., Sassa, Y., Sakai, C., Takata, M., Hayashi, S., Nagai, M., Furuya, T., Moriyama, H., Satoh, T., Ono, S. & Mizutani, T. 2015: Identification, characterization and full-length sequence analysis of a novel dsRNA virus isolated from the arboreal ant *Camponotus yamaokai*. – *Journal of General Virology* 96: 1930-1937.

Lester, P.J., Buick, K.H., Baty, J.W., Felden, A. & Haywood, J. 2019: Different bacterial and viral pathogens trigger distinct immune responses in a globally invasive ant. – *Scientific Reports* 9: 5780.

Levitt, A.L., Singh, R., Cox-Foster, D.L., Rajotte, E., Hoover, K., Ostiguy, N. & Holmes, E.C. 2013: Cross-species transmission of honey bee viruses in associated arthropods. – *Virus Research* 176: 232-240.

Li, C.X., Shi, M., Tian, J.H., Lin, X.D., Kang, Y.J., Chen, L.J., Qin, X.C., Xu, J., Holmes, E.C. & Zhang, Y.Z. 2015: Unprecedented genomic diversity of RNA viruses in arthropods reveals the ancestry of negative-sense RNA viruses. – *eLife* 4.

Li, J.B., Heinz, K.M., Flexner, J.L. & McCutchen, B.F. 1999: Effects of recombinant baculoviruses on three nontarget heliothine predators. – *Biological Control* 15: 293-302.

Manfredini, F., Shoemaker, D. & Grozinger, C.M. 2016: Dynamic changes in host-virus interactions associated with colony founding and social environment in fire ant queens (*Solenopsis invicta*). – *Ecology and Evolution* 6: 233-244.

Oi, D. & Valles, S. 2009: Fire Ant Control with Entomopathogens in the USA. In: Hajek, A.E., Glare, T.R. & O'Callaghan, M. (Ed.): *Use of Microbes for Control and Eradication of Invasive Arthropods*. – Springer Science, New York, NY, USA, pp. 237-258.

Olendraite, I., Brown, K., Valles, S.M., Firth, A.E., Chen, Y., Guérin, D.M.A., Hashimoto, Y., Herrero, S., de Miranda, J.R. & Ryabov, E.V. 2019: ICTV Virus Taxonomy Profile: Polycipiviridae. – *Journal of General Virology* 100: 554-555.

Olendraite, I., Lukhovitskaya, N.I., Porter, S.D., Valles, S.M. & Firth, A.E. 2017: Polycipiviridae: a proposed new family of polycistronic picorna-like RNA viruses. – *Journal of General Virology* 98: 2368-2378.

Payne, A.N., Shepherd, T.F. & Rangel, J. 2020: The detection of honey bee (*Apis mellifera*)-associated viruses in ants. – *Scientific Reports* 10: 2923.

Porter, S.D., Gavilanez-Slone, J.M. & Valles, S.M. 2016: *Solenopsis invicta* virus 3: infection tests with adult honey bees (Hymenoptera: Apidae). – *Florida Entomologist* 99: 729-733.

Porter, S.D., Valles, S.M. & Oi, D.H. 2013: Host specificity and colony impacts of the fire ant pathogen, *Solenopsis invicta* virus 3. – *Journal of Invertebrate Pathology* 114: 1-6.

Powell, C.M., Hanson, J.D. & Bextine, B.R. 2014: Bacterial community survey of *Solenopsis invicta* Buren (red imported fire ant) colonies in the presence and absence of *Solenopsis invicta* virus (SINV). – *Current Microbiology* 69: 580-585.

Schläppi, D., Chejanovsky, N., Yanez, O. & Neumann, P. 2020: Foodborne Transmission and Clinical Symptoms of Honey Bee Viruses in Ants *Lasius* spp. – *Viruses* 12.

Sebastien, A., Lester, P.J., Hall, R.J., Wang, J., Moore, N.E. & Gruber, M.A. 2015: Invasive ants carry novel viruses in their new range and form reservoirs for a honeybee pathogen. – *Biology Letters* 11: 20150610.

Tufts, D.M., Hunter, W.B. & Bextine, B. 2010: Discovery and effects of Texas *Solenopsis invicta* virus [SINV-1 (TX5)] on red imported fire ant populations. – *Journal of Invertebrate Pathology* 104: 180-185.

Tufts, D.M., Hunter, W.B. & Bextine, B. 2014: *Solenopsis invicta* Virus (Sinv-1) Infection and Insecticide Interactions in the Red Imported Fire Ant (Hymenoptera: Formicidae). – *Florida Entomologist* 97: 1251-1254.

Valles, S.M. 2012: Positive-strand RNA viruses infecting the red imported fire ant, *Solenopsis invicta*. – *Psyche: A Journal of Entomology* 2012: 1-14.

Valles, S.M. & Hashimoto, Y. 2009: Isolation and characterization of *Solenopsis invicta* virus 3, a new positive-strand RNA virus infecting the red imported fire ant, *Solenopsis invicta*. – *Virology* 388: 354-361.

Valles, S.M., Oi, D.H., Becnel, J.J., Wetterer, J.K., LaPolla, J.S. & Firth, A.E. 2016: Isolation and characterization of *Nylanderia fulva* virus 1, a positive-sense, single-stranded RNA virus infecting the tawny crazy ant, *Nylanderia fulva*. – *Virology* 496: 244-254.

Valles, S.M., Oliver, J.B. & Adesso, K.M. 2017: Complete genome sequence of a new isolate of *Solenopsis invicta* virus 3 from *Solenopsis invicta* x *richteri* Hybrid Ants. – *Genome Announcements* 5: e01273-01217.

Valles, S.M., Porter, S.D. & Calcaterra, L.A. 2018: Prospecting for viral natural enemies of the fire ant *Solenopsis invicta* in Argentina. – *PLoS One* 13: e0192377.

Valles, S.M., Porter, S.D. & Firth, A.E. 2014: *Solenopsis invicta* virus 3: pathogenesis and stage specificity in red imported fire ants. – *Virology* 460-461: 66-71.

Valles, S.M. & Rivers, A.R. 2019: Nine new RNA viruses associated with the fire ant *Solenopsis invicta* from its native range. – *Virus Genes* 55: 368-380.

Valles, S.M., Shoemaker, D., Wurm, Y., Strong, C.A., Varone, L., Becnel, J.J. & Shirk, P.D. 2013: Discovery and molecular characterization of an ambisense densovirus from South American populations of *Solenopsis invicta*. – *Biological Control* 67: 431-439.

Valles, S.M. & Strong, C.A. 2005: *Solenopsis invicta* virus-1A (SINV-1A): distinct species or genotype of SINV-1? – *Journal of Invertebrate Pathology* 88: 232-237.

Valles, S.M., Strong, C.A., Dang, P.M., Hunter, W.B., Pereira, R.M., Oi, D.H., Shapiro, A.M. & Williams, D.F. 2004: A picorna-like virus from the red imported fire ant, *Solenopsis invicta*: initial discovery, genome sequence, and characterization. – *Virology* 328: 151-157.

Valles, S.M., Strong, C.A. & Hashimoto, Y. 2007a: A new positive-strand RNA virus with unique genome characteristics from the red imported fire ant, *Solenopsis invicta*. – *Virology* 365: 457-463.

Valles, S.M., Strong, C.A., Oi, D.H., Porter, S.D., Pereira, R.M., Vander Meer, R.K., Hashimoto, Y., Hooper-Bui, L.M., Sanchez-Arroyo, H., Davis, T., Karpakakunjaram, V., Vail, K.M., Fudd Graham, L.C., Briano, J.A., Calcaterra, L.A., Gilbert, L.E., Ward, R., Ward, K., Oliver, J.B., Taniguchi, G. & Thompson, D.C. 2007b: Phenology, distribution, and host specificity of *Solenopsis invicta* virus-1. – *Journal of Invertebrate Pathology* 96: 18-27.

Viljakainen, L., Holmberg, I., Abril, S. & Jurvansuu, J. 2018: Viruses of invasive Argentine ants from the European Main supercolony: characterization, interactions and evolution. – *Journal of General Virology* 99: 1129-1140.