The complete mitochondrial genome of *Rhopalosiphum nymphaeae* (Linnaeus, 1761) (Hemiptera: Aphididae)

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**ABSTRACT**

*Rhopalosiphum nymphaeae* (Linnaeus, 1761) is a heteroecious polyphagous aphid, which can survive underwater. We have determined mitochondrial genome of *R. nymphaeae* collected in Korea. The circular mitogenome of *R. nymphaeae* is 15,594 bp including 13 protein-coding genes, two ribosomal RNA genes, 22 transfer RNAs, and a single large non-coding region of 874 bp. The base composition was AT-biased (84.3%). Phylogenetic trees present that genus *Rhopalosiphum* is polyphyletic, requiring more investigation of mitochondrial genomes.

Water lily aphid, *Rhopalosiphum nymphaeae* (Linnaeus, 1761) is a heteroecious polyphagous aphid having *Prunus* species as winter hosts (Blackman and Eastop 2008) and inhabiting numerous wetland and water-dwelling plant species in summer (Atousa et al. 2015). This aphid is able to survive underwater (Holman 2009; Blackman and Eastop 2015). Its host list includes species of 45 plant families (Holman 2009). It has been reported as a pest (Hance et al. 1994) but has also been used to control water weeds in California (Oraze and Grigarick 1992). Till now there is no available complete mitochondrial genome of *Rhopalosiphum* genus.

Here, we presented mitochondrial genome collected in Korea (36° 47′46.3″N 126° 08′55.0″E; voucher was deposited in in Gyeongsang National University, Korea accession number: Coll#WH101). DNA was extracted using DNeasy Blood & Tissue Kit (QIAGEN, Hilden, Germany). Raw sequences obtained from Illumina HiSeq2000 (Macrogen Inc., South Korea) were filtered by Trimmomatic 0.33 (Bolger et al. 2014) and de novo assembled by Velvet 1.2.10 (Zerbino and Birney 2008), SOAPGapCloser 1.12 (Zhao et al. 2011), BWA 0.7.17, and SAMtools 1.9 (Li et al. 2009; Li 2013). Geneious R11 11.1.5 (Biomatters Ltd, Auckland, New Zealand) was used to annotate mitochondrial genome based on that of *Aphis gossypii* (MN102349; Park, Jung, et al. 2019), *Paracolopha morrisoni* (Lee et al. 2019), and *Myzus persicae*. Gene order of *R. nymphaeae* mitogenomes is identical to those of Aphididae species.

LR722139 sequence originated from *Nymphaea colorata* genome (Zhang et al. 2020) presented high nucleotide similarity with our mitogenome with two times duplicated regions. After removing repeat regions, 5 SNPs and 339 INDELs are identified. Most of INDELs are from 233-bp insertion in control region. Because of INDELs on genic region, this sequence should be corrected in near future. Number of SNPs and INDELs is smaller than those of *Chilo suppressalis* (Kwon, Kim, et al. 2019) and *Spodoptera frugiperda* (Lee, Lee, et al. 2019) and larger than those of *Nilaparvata lugens* (Choi et al. 2019; Kwon, Min, et al. 2019), *Laodelphax striatellus* (Park, Jung, et al. 2019; Seo, Jung, et al. 2019), *Aphis gossypii* (Park, Xi, et al., 2019), *Stegobium panicum* (Park et al., under review), and *Hipparchia autonoe* (Lee et al., in preparation).

We inferred the phylogenetic relationship with 49 Aphididae mitogenomes including one outgroup species, *Bemisia tabaci* (Tay et al. 2016). Neighbor joining (10,000 bootstrap repeats) and maximum likelihood (1,000 bootstrap repeats) phylogenetic trees were constructed using MEGA X (Kumar et al. 2018) based on multiple sequence alignment of adjusted complete mitogenomes by MAFFT 7.450 (Katoh and Standley 2013). Phylogenetic trees present that *Rhopalosiphum* genus is polyphyletic with high bootstrap values and LR722139 is similar to our mitogenome (Figure 1).
Figure 1. Neighbor joining (10,000 bootstrap repeats) and maximum likelihood (1,000 bootstrap repeats) phylogenetic trees of 48 insect species in the family Aphididae, *R. nymphaea* (MN943499 and trimmed LR722139 sequence), *Rhopalosiphum maidis* (MK368778, two *Aphids gossypii* (NC_011594, AC_024683, Sitobion avenae (NC_022682, Cavia lirica (NC_022682, *Schizaphis graminum* (NC_006158), *Aphis fabae mordvilkoi* (NC_039988), *Aphis craccivora* New world, *Aphis fabae mordvilkoi* (NC_039988), *Aphis craccivora* Old world, *Aphis gossypii* (NC_024683, *Aphis gossypii* (NC_024683, *Aphis citricidus* (NC_043903), *Aphis glycines* (KT889380 and MK111111), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagallis* (MF043987), *Kaburagia rhusicola ovagalli
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