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Trends in Genetics - Genome of the month

Acyrthosiphon pisum

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Aphids are sap-sucking insects that comprise about 4700 species colonizing a wide variety of host plants. They are the dominant group (26%) among insect pests of the six main crops grown for human consumption, with the potential to cause worldwide economic impact. Aphids inflict damage directly by feeding and indirectly by phytovirus transmission. Since the initial sequencing of the genome of the pea aphid, *Acyrthosiphon pisum* and its symbiont *Buchnera aphidicola*, a further 12 aphid genome sequences have become available . Most of these genomes are accessible at the dedicated AphidBase[i]. Fourteen *Buchnera* genomes have also been sequenced. This provides a unique opportunity to study selection, adaptation, and evolution using aphids as a model family of species with broad distribution and adaptation to different environments and food sources. In addition, the availability of the genomes will facilitate future comparative studies focusing on the development, physiology and metabolism of aphids to identify novel pest control strategies.

TAXONOMY AND CLASSIFICATION:
KINGDOM: Animalia
PHYLUM: Arthropoda
CLASS: Insecta
ORDER: Hemiptera
SUPERFAMILY: Aphididoidea
FAMILY: Aphididae
GENUS: *Acyrthosiphon*

GENOME FACTS:
- The genome of *A. pisum* was the first sequenced genome of a hemimetabolous and hemipteran insect.
- The haploid genome comprises 4 chromosomes for a genome size of 542Mb and a total number of 18890 genes: 17317 protein coding genes, 163 miRNA and 945 lncRNAs (NCBI Annotation release 101).
- The genome is characterized by gene family duplications/expansions, and by loss/reduction of others (metabolic pathways and antibacterial defense pathways (e.g. IMD pathway, PGRPs, defensins, cecropins).
- There is significant expansion of genes encoding transporters (e.g. amino acid transporters, digestive enzymes, and RNAi machinery).

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SPECIES FACTS:

- *A. pisum* is a soft-bodied insect that alternates between parthenogenetic, viviparous reproduction and sexual oviparous reproduction. Sexual reproduction is initiated upon lengthening of nights and reduction of temperature.
- It is a relatively large aphid (several millimeters in adults), readily reared on plants or on artificial medium in the laboratory.
- Aphids comprise different morphs (winged and non-winged), the occurrence of which is determined by population density and/or presence of danger.
- Aphids have a novel cell type, the bacteriocyte, that was initially assumed to simply house the endosymbiotic bacteria. However, recent data reveals a more prominent role in physiological plasticity by controlling nutritional needs when facing physiological or environmental constraints.
- *A. pisum* is readily tractable experimentally with genome editing methods becoming available.

FUN FACT ABOUT THE GENOME:

Novel genes are found with thus far unknown functions. These include BCRs (bacteriocyte cysteine-rich peptides) and SPs (Secreted Proteins), and a class of putative zinc finger containing transcription factors. It has been suggested that the BCRs may be related to the presence of endosymbionts while the Zn-finger TFs may play a role in phenotypic plasticity of aphids.

Resources

[i] https://bipaa.genouest.org/is/aphidbase/

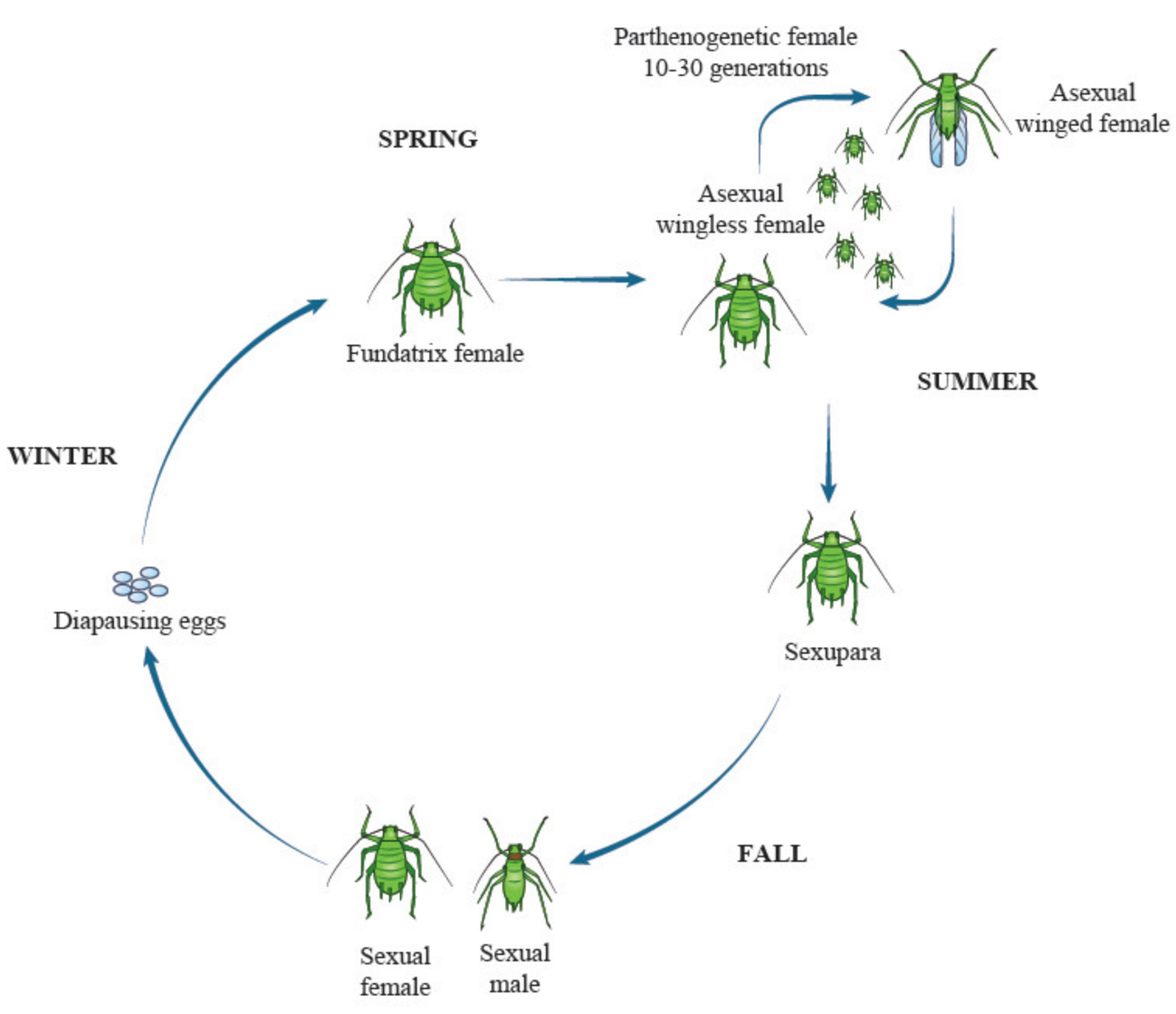
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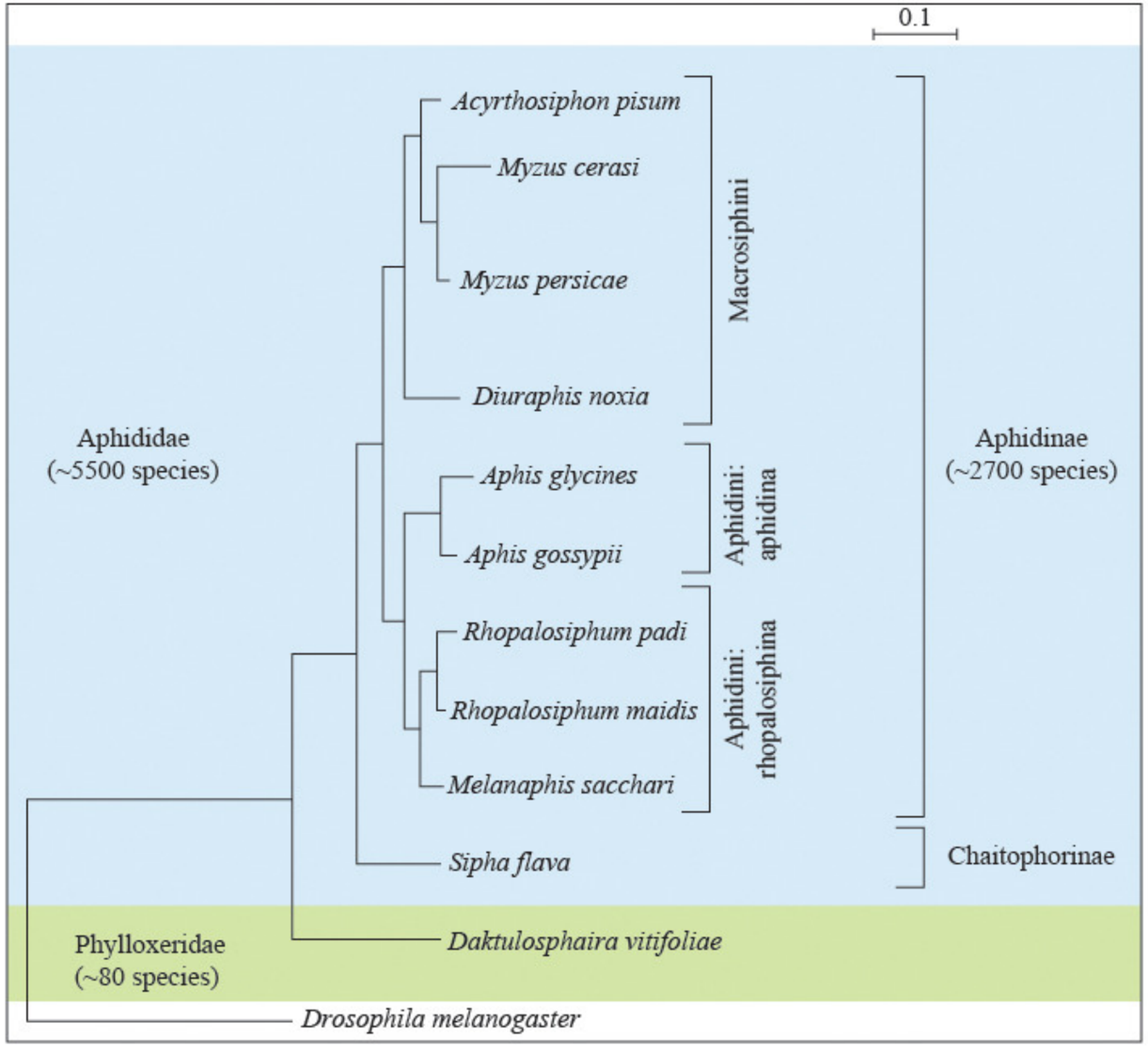
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Parthenogenetic female
10-30 generations
Asexual
winged female
SPRING
Asexual
wingless female
Fundatrix female
SUMMER
WINTER
Diapausing eggs
Sexupara
FALL
Sexual
female
Sexual
male


0.1
Acyrthosiphon pisum
Myzus cerasi
Myzus persicae
Diuraphis noxia
Macrosiphini
Aphididae
(~5500 species)
Aphis glycines
Aphis gossypii
Aphidini:
aphidina
Rhopalosiphum padi
Rhopalosiphum maidis
Melanaphis sacchari
Aphidini:
rhopalosiphina
Aphidinae
(~2700 species)
Sipha flava
Chaitophorinae
Phylloxeridae
(~80 species)
Daktulosphaira vitifoliae
Drosophila melanogaster



