



# *Candidatus* Liberibacter asiaticus manipulates the expression of vitellogenin, cytoskeleton, and endocytotic pathway-related genes to become circulative in its vector, *Diaphorina citri* (Hemiptera: Psyllidae)

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## Abstract

Citrus greening disease or huanglongbing (HLB) caused by *Candidatus* Liberibacter asiaticus (CLAs) limits citrus production worldwide. CLAs is transmitted by the Asian citrus psyllid (ACP), *Diaphorina citri* (Hemiptera: Psyllidae) in a persistent-propagative manner. Understanding the molecular interaction between CLAs and ACP and interrupting the interrelationship can provide an alternative to insecticides for managing citrus greening disease. Transcriptome analysis of ACP in response to CLAs showed differential expression of 3911 genes (2196 upregulated, and 1715 downregulated) including the key genes of ACP involved in cytoskeleton synthesis and nutrition-related proteins, such as vitellogenins, extensin, laminin, tropomyosin, troponin C, and flightin. Majority of the differentially expressed genes were categorized under molecular functions followed by cellular components and biological processes. KEGG pathway analysis showed differential regulation of carbohydrate, nucleotide, and energy metabolic pathways, the endocytotic pathway, and the defense-related pathways. Differential regulation of genes associated with the key pathways might favour CLAs to become systemic and propagate in its insect vector. The study provides an understanding of genes involved in circulation of CLAs in ACP. The candidate genes involved in key physiological processes and CLAs transmission by ACP would be potential targets for sustainable management of ACP and CLAs.

**Keywords** Asian citrus psyllid · Citrus greening bacterium · Huanglongbing · Transcriptomics · Virus–vector relationship · Vitellogenin · Cytoskeleton · Endocytotic pathway

## Introduction

Citrus greening disease, also known as huanglongbing (HLB) is a major limiting factor in citrus production worldwide. The disease is incited by a fastidious, phloem-limited,  $\alpha$ -proteobacterium *Candidatus* Liberibacter spp. Three species viz. *Candidatus* Liberibacter asiaticus (CLAs), *C. L. africanus* (CLaf), and *C. L. americanus* (CLam) are reported to be associated with the disease (Bové 2006; Gottwald et al. 2007; Vyas et al. 2015). Among them, CLAs is the most widespread destroying about 100 million citrus trees in Asia (Gottwald et al. 2007). Infection of HLB induces yellow shoots, leaves with blotchy mottles, and small lopsided fruits. HLB is transported both upward and downward through the tree but their distribution is patchy. The infected branches start to die back and the infected tree dries up gradually. CLAs and CLam are transmitted by Asian citrus psyllid

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