

2011

# Complete Genome Sequence of the Plant Growth-Promoting Endophyte *Burkholderia phytofirmans* Strain PsJN

Alexandra Weilharter  
*AIT Austrian Institute of Technology GmbH*

Birgit Mitter  
*AIT Austrian Institute of Technology GmbH*

Maria V. Shin  
*Department of Energy (DOE) Joint Genome Institute*

Patrick S. G. Chain  
*Department of Energy (DOE) Joint Genome Institute*

Jerzy Nowak  
*Virginia Polytechnic Institute and State University*

*See next page for additional authors*

Follow this and additional works at: <http://digitalcommons.unl.edu/usdoepub>

 Part of the [Bioresource and Agricultural Engineering Commons](#)

---

Weilharter, Alexandra; Mitter, Birgit; Shin, Maria V.; Chain, Patrick S. G.; Nowak, Jerzy; and Sessitsch, Angela, "Complete Genome Sequence of the Plant Growth-Promoting Endophyte *Burkholderia phytofirmans* Strain PsJN" (2011). *US Department of Energy Publications*. 296.  
<http://digitalcommons.unl.edu/usdoepub/296>

This Article is brought to you for free and open access by the U.S. Department of Energy at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in US Department of Energy Publications by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

---

**Authors**

Alexandra Weilharter, Birgit Mitter, Maria V. Shin, Patrick S. G. Chain, Jerzy Nowak, and Angela Sessitsch

# Complete Genome Sequence of the Plant Growth-Promoting Endophyte *Burkholderia phytofirmans* Strain PsJN<sup>∇</sup>

Alexandra Weilharter,<sup>1</sup> Birgit Mitter,<sup>1</sup> Maria V. Shin,<sup>2</sup> Patrick S. G. Chain,<sup>2,3</sup>  
Jerzy Nowak,<sup>4</sup> and Angela Sessitsch<sup>1\*</sup>

AIT Austrian Institute of Technology GmbH, Bioresources Unit, A-3430 Tulln, Austria<sup>1</sup>; Department of Energy (DOE) Joint Genome Institute, Walnut Creek, California<sup>2</sup>; Los Alamos National Laboratory, Los Alamos, New Mexico<sup>3</sup>; and Virginia Polytechnic Institute and State University, Blacksburg, Virginia<sup>4</sup>

Received 10 April 2011/Accepted 27 April 2011

***Burkholderia phytofirmans* PsJN<sup>T</sup> is able to efficiently colonize the rhizosphere, root, and above-ground plant tissues of a wide variety of genetically unrelated plants, such as potatoes, canola, maize, and grapevines. Strain PsJN shows strong plant growth-promoting effects and was reported to enhance plant vigor and resistance to biotic and abiotic stresses. Here, we report the genome sequence of this strain, which indicates the presence of multiple traits relevant for endophytic colonization and plant growth promotion.**

Bacterial endophytes are interesting candidates for application for biocontrol, plant fortification, and phytoremediation (3, 6). *Burkholderia phytofirmans* PsJN<sup>T</sup> is a prominent and efficient plant growth-promoting endophyte (2, 5, 9), which was isolated from *Glomus vesiculiferum*-infected onion roots (4, 7).

Sequencing of the PsJN genome was performed at the Department of Energy (DOE) Joint Genome Institute via Sanger sequencing to a depth of ~11-fold coverage. All gaps in the draft assembly were scaffolded using mate pair PCR information and closed by primer walking off clones or PCR products. All nucleotide and repeat ambiguities were resolved by resequencing from additional clones or PCR products, and thus the genome is completed at the “finished” level (1). The genome was loaded into IMG/M-ER for gene prediction and annotation, as described elsewhere ([http://img.jgi.doe.gov/er/doc/about\\_index.html](http://img.jgi.doe.gov/er/doc/about_index.html)). The 8.2-Mb genome of strain PsJN consists of two chromosomes and one plasmid and contains a total of 7,405 genes. The gene coding density is 86.7%, and the G+C content is 62.3%. In total, 5,515 genes (73.7%) are assigned to predicted functions. Chromosome 1 contains a higher number of coding sequences (CDSs) involved in core functions like cell division, central metabolism, and other housekeeping functions, whereas chromosome 2 carries genes coding for accessory functions, such as genes for protective response, heavy metal resistance, and niche-habitat-specific properties. Interestingly, 71% of the plasmid CDSs (49/128) have no known function. Three rRNA gene operons were found, which are located on the two chromosomes. Sixty-three tRNA genes encoding all amino acids are located mainly on chromosome 1. At the genomic level, strain PsJN is most closely related to *Burkholderia xenovorans* LB400. More than 3,371 PsJN genes show more than 90% sequence similarity to strain LB400, and a Pearson coefficient of 0.94% indicates high genome synteny.

1-Aminocyclopropane-1-carboxylate (ACC) deaminase activity and the production of indole-3-acetic acid (IAA) contribute to the plant growth-promoting activity of strain PsJN (8). Besides the presence of an *acdS-acdR* operon, the genome sequence of PsJN indicates the presence of two independent IAA synthesis pathways, the indole-3-acetamide pathway and the tryptophan side chain oxidase pathway. No nitrogen fixation-encoding genes were found, and the genome does not indicate the production of antibiotics. PsJN carries two N-acyl homoserine lactone (AHL) and one 3-hydroxypalmitic-acid-methyl-ester-type quorum-sensing operons. The presence of genes encoding plant cell wall-degrading enzymes such as cellulases and endoglucanases as well as flagellar proteins explains the systemic internal plant colonization by this strain. The PsJN genome shows a range of detoxification mechanisms, including degradation of organic substances, heavy metal efflux systems, and various enzymes necessary to cope with oxidative stress. These features in combination with numerous (ABC-type) transporters and carbon source utilization pathways are likely to enable strain PsJN to successfully colonize a wide variety of plant habitats.

**Nucleotide sequence accession numbers.** The sequence data have been deposited in NCBI GenBank under project accession no. CP001052, CP001053, and CP001054.

We thank Jim Tiedje and Alban Ramette for encouragement and the initiative to sequence the genome of strain PsJN.

This work was supported by a grant provided by the FWF (National Science Foundation grant no. P 21261-B03). The sequencing for the project was provided through the U.S. Department of Energy (DOE) Sequencing Program (<http://www.jgi.doe.gov/CSP/index.html>). This work was performed at Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, and Los Alamos National Laboratory, under the auspices of the U.S. DOE's Office of Science, Biological and Environmental Research Program under contract no. DE-AC02-05CH11231.

## REFERENCES

1. Chain, P. S. G., et al. 2009. Genomics genome project standards in a new era of sequencing. *Science* **326**:236–237.
2. Compant, S., et al. 2005. Endophytic colonization of *Vitis vinifera* L. by plant growth-promoting bacterium *Burkholderia* sp. strain PsJN. *Appl. Environ. Microbiol.* **71**:1685–1693.
3. Compant, S., C. Clément, and A. Sessitsch. 2010. Plant growth-promoting

\* Corresponding author. Mailing address: AIT Austrian Institute of Technology GmbH, Department of Health & Environment, Bioresources Unit, Konrad-Lorenz-Strasse 24, A-3430 Tulln, Austria. Phone: 43 0 50550 3509. Fax: 43 0 50550 3666. E-mail: angela.sessitsch@ait.ac.at.

<sup>∇</sup> Published ahead of print on 6 May 2011.

- bacteria in the rhizo- and endosphere of plants: their role, colonization, mechanisms involved and prospects for utilization. *Soil Biol. Biochem.* **42**: 669–768.
4. **Frommel, M. I., J. Nowak, and G. Lazarovits.** 1991. Growth enhancement and developmental modifications of in vitro grown potato (*Solanum tuberosum* ssp. *tuberosum*) as affected by a nonfluorescent *Pseudomonas* sp. *Plant Physiol.* **96**:928–936.
  5. **Pillay, V. K., and J. Nowak.** 1997. Inoculum density, temperature, and genotype effects on in vitro growth promotion and epiphytic and endophytic colonization of tomato (*Lycopersicon esculentum* L.) seedlings inoculated with a pseudomonad bacterium. *Can. J. Microbiol.* **43**:354–361.
  6. **Ryan, R. P., G. Kieran, A. Franks, D. J. Ryan, and D. N. Dowling.** 2008. Bacterial endophytes: recent developments and applications. *FEMS Microbiol. Lett.* **278**:1–9.
  7. **Sessitsch, A., et al.** 2005. *Burkholderia phytofirmans* sp. nov., a novel plant-associated bacterium with plant beneficial properties. *Int. J. Syst. Evol. Microbiol.* **55**:1187–1192.
  8. **Sun, Y., Z. Cheng, and B. R. Glick.** 2009. The presence of a 1-aminocyclopropane-1-carboxylate (ACC) deaminase deletion mutation alters the physiology of the endophytic plant growth-promoting bacterium *Burkholderia phytofirmans* PsJN. *FEMS Microbiol. Lett.* **296**:131–136.
  9. **Wang, K., K. Conn, and G. Lazarovits.** 2006. Involvement of quinolinate phosphoribosyl transferase in promotion of potato growth by a *Burkholderia* strain. *Appl. Environ. Microbiol.* **72**:760–768.