

***Brassica napus* Endophytes Have the Potential to Protect the Crop against the Blackleg Disease Causal Agent, the Fungus *Leptosphaeria maculans* †**

Ezequiel Peral-Aranega ^{1,2}, Zaki Saati-Santamaría ^{1,2}, Raúl Rivas ^{1,2,3} and Paula García-Fraile ^{1,2,3}

¹ Microbiology and Genetics Department, University of Salamanca, 37007 Salamanca, Spain

² Spanish-Portuguese Institute for Agricultural Research (CIALE), 37185 Salamanca, Spain

³ Associated Research Unit of Plant-Microorganism Interaction, University of Salamanca-IRNASA-CSIC, 37008 Salamanca, Spain

Abstract: According to the UN, the World population is going to achieve 8.000 million people imminently [1]. Finding a sustainable and efficient way to feed the growing population is one of the major challenges of this generation.

Crop yields can be promoted by *plant growth promoting* (PGP) bacteria in substitution of chemical fertilization, which has shown to cause a wide list of environmental harms. On the other side, pest control with chemical biocides is not only harmful for the environment but could also be a direct cause of human disease. For this reason, BCA (biological control agents) are being studied. Microorganisms can aid crops against the attack of phytopathogens, by direct antagonism (growth inhibition, p.e.) or by the early activation of the plant defense mechanisms *-priming-* [2].

In this study, 49 *Brassica napus* bacterial endophytes were tested in vitro as antagonists of the fungus *Leptosphaeria maculans*, the causal agent of the most damaging disease of this crop [3]. The screening allowed us to find 13 endophytes with high in vitro antifungal potential. Two *Pseudomonas* strains, belonging to the species *P. brassicacearum* and *P. orientalis*, respectively, greatly inhibited the fungus. Genomes sequences of these strains were sequenced, and their genetic potential to produce secondary metabolites was analyzed on the antiSMASH platform (v5.1.2). Both strains genome analyses showed diverse biosynthetic gene clusters (BGCs) that may be implicated in the production of novel secondary metabolites that might be implicated in the antifungal activity, according to its relative similarity to other BGCs in the platform database.

Funding: This work was funded from the European Union's Horizon 2020 research and innovation programme under grant agreement No 750795.

1. UN Department of Economic and Social Affairs. Available online: <https://www.un.org/development/desa/en/news/population/world-population-prospects-2019.html> (Accessed on 07/09/2020).

2. García-Fraile, P.; Menéndez, E.; Rivas, R. Role of bacterial biofertilizers in agriculture and forestry. *AIMS Bioeng.* 2015, 2, 183–205, doi:10.3934/bioeng.2015.3.183.

3. Marcroft, S.J.; Sosnowski, M.R.; Scott, E.S.; Ramsey, M.D.; Salisbury, P.A.; Howlett, B.J. *Brassica napus* plants infected by *Leptosphaeria maculans* after the third to fifth leaf growth stage in south-eastern Australia do not develop blackleg stem canker. *Eur. J. Plant Pathol.* 2005, 112, 289–292, doi:10.1007/s10658-005-1050-1.