Title: RESPONSE SYSTEM OF TWO STRAINS OF *Bacillus megaterium* ISOLATED FROM SOIL AND WATER TO THE CALLISTO® HERBICIDE

Authors Dobrzanski, T.[1], Olchanheski, L.R.[2], Beltrame, F.L.[1], Gravina, F.[1], Pileggi, S.A.V.[1], Batista, J.S.S.[1], Pileggi, M.[1]

Institution [1]UEPG – Universidade Estadual de Ponta Grossa, Programa de Pós-Graduação em Biologia Evolutiva (Avenida General Carlos Cavalcanti 4748 - 84030-900 – Uvaranas - Ponta Grossa - PR), [2]USP - Universidade de São Paulo (Avenida Prof. Lineu Prestes, 2415 - 05508900 - Cidade Universitária – SP)

Summary:

The intense use of herbicides in agriculture for weed control causes a selective pressure on the soil microbiota and waters surrounding the application areas, altering the environmental balance. Some microorganisms develop degradation metabolic pathways for these xenobiotics. However, tolerance and degradation processes can generate free radicals that may affect their survival. This study aimed to analyze the responses system shown by bacterial strains under selective pressure by Callisto® herbicide. Isolated strains were identified as *Bacillus megaterium* CCT7729, from soil, and *B. megaterium* CCT7730, from water, and they presented different routes of mesotrione degradation with metabolites not yet reported in the literature. The active ingredient mesotrione and their degradation metabolites, and especially the formulated Callisto® herbicide, affected the viability of these strains and their cell membrane lipids. *B. megaterium* CCT7729 showed a higher efficiency to degrade mesotrione, lower peroxide and MDA production rates, higher SOD activity and lower catalase activity, when compared with the strain *B. megaterium* CCT7730. In addition, differential changes in membrane lipids, produced by distinct membrane saturation states of each strain, were observed by Fourier Transforme Infrared Spectroscopy (FTIR) analyses. In this way, the permeability to mesotrione was modified, resulting in different antioxidative responses patterns, and specific cellular redox environments. Consequently, *B. megaterium* strains showed distinct mesotrione degradation pathways and Liquid Chromatography-tandem Mass Spectrometry (LC-MS/MS) profiles. These data could indicate specific defense strategies against oxidative stress in soil and water, by mechanisms based on phenotype plasticity in bacteria, for better adaptation.

Keywords: herbicide degradation, herbicide metabolic pathway, lipid membrane saturation, oxidative stress, responses system

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