Bioprophylaxis - how to reduce pesticide contamination in agricultural soils

Louis Carles[1,2,3], Pascale Besse-Hoggan[1,3] and Isabelle Batisson[1,2]

[1] Clermont Université, Université Blaise Pascal, F-63000 Clermont-Ferrand, France
[2] CNRS, UMR 6023, Laboratoire Microorganismes : Génome et Environnement, F-63178 Aubière, France
[3] CNRS, UMR 6296, Institut de Chimie de Clermont-Ferrand, F-63178 Aubière, France
e-mail contact: louis.carles64@gmail.com

Context and objectives

The major problem with pesticides is linked to the more or less substantial proportion of the active ingredient quantity spread that does not reach its intended target and contaminates the environmental compartments. We propose to develop a **bioprophylactic process** based on the **simultaneous application of pesticide and pesticide-degrading microorganisms**, providing optimal conditions for microbial degradation of pesticides after their specific action and before their transport to the surrounding ecosystems. Up to now, studies related to bioprophylaxis rather focused on non-agricultural uses of pesticides.

The aim of our study was to determine the suitability of this concept in agriculture, using the herbicide 2,4-dichlorophenoxyacetic acid (2,4-D) as a model and a bacterial degrading-strain (*Cupriavidus necator* JMP134).

Materials & methods

Soil microcosms → **Spreading** → **Incubation** → **Parameter analyses**

Condition: A, B, C

- 100 g dw soil
- 20% humidity
- 4 replicates
- Planted with:
  - Wheat (non-sensitive)
  - Mustard (sensitive)

+ *C. necator* JMP134, 10^5 cell g^{-1} dw soil

+ DAM® *Agriphar* agronomic dose 4.23 µg 2,4-D g^{-1} dw soil

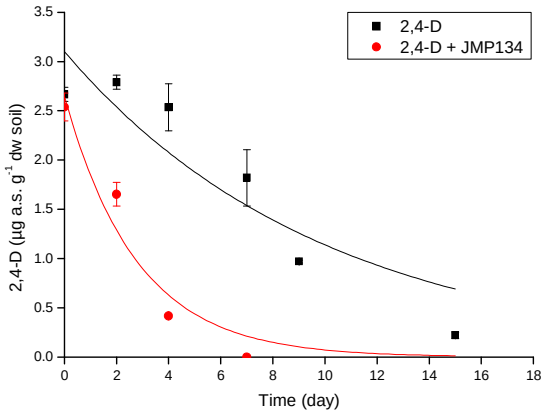
+ DAM + *C. necator* JMP134

Incubation: 20°C, Day/night cycle (14:10), Constant humidity

1. - Degradation of 2,4-D in soil ? HPLC analyses
2. - Survival rate of *C. necator* JMP134? Enumeration on plates
3. - Herbicidal effect ? Visual observation

Results

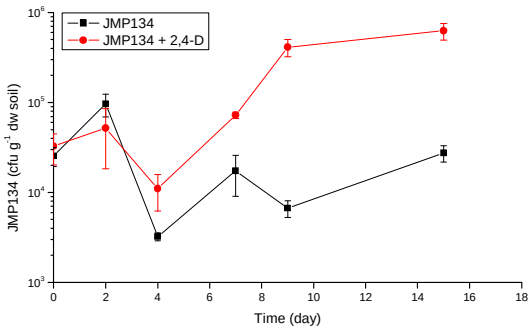
1 Degradation of 2,4-D in soil



Treatment	2,4-D	2,4-D + *C. necator* JMP134
Parameters		
Dissipation rate, *k* (day^{-1})	0.1	0.4
Dissipation time 50%, DT_{50} (day)	6.9	1.9

Reduction of 2,4-D persistence in soil

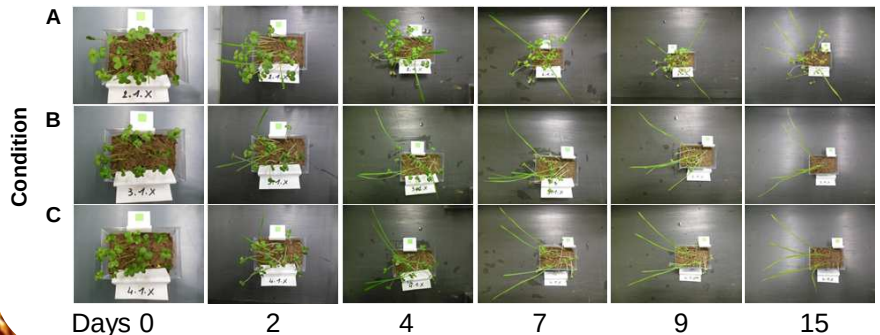
2 Survival rate of inoculated *C. necator* JMP134 in soil



➔ Slight increase in *C. necator* JMP134 abundance in soil in the presence of 2,4-D

➔ No differences in *C. necator* JMP134 abundance in soil without 2,4-D

3 Herbicidal effect



DAM

DAM + 

Conclusions

In the soil inoculated with *C. necator* JMP134, **the herbicidal effect was conserved and 2,4-D has been completely degraded within seven days**, while only 55% degradation was observed in the non-inoculated control.

By using realistic conditions as close as possible to those in the field (*i.e.* recommended field dose of pesticide, commercial formulation), our study constitutes the first bases for the development of bioprophylaxis as a good means to reduce environmental contamination by agricultural pesticides.