

# Phenylurea Herbicide Biodegradation in Aqueous Solution using bioaugmentation strategies with *Advenella sp.* JRO

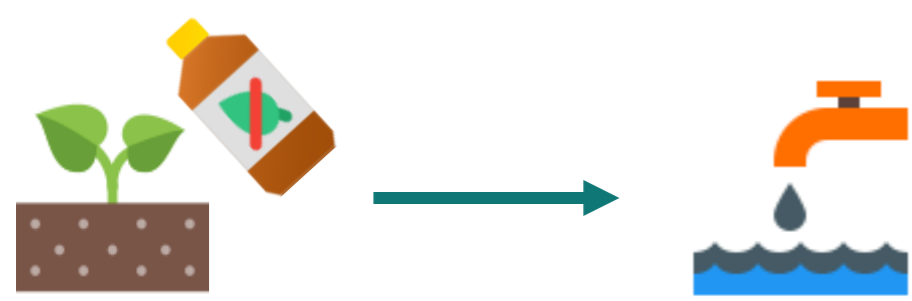
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## INTRODUCTION & AIM



**Phenylurea herbicides (PUHs):** These compounds exhibit persistence in soils and aquatic environments, leading to their regular detection in groundwater above the 0.1 µg L<sup>-1</sup> threshold.



Environmental concern over PUHs arises not only from their persistence but also from reported **carcinogenic, mutagenic, teratogenic, genotoxic and endocrine-disrupting effects** in wildlife and humans.



**Soil impact:** they alter soil microbiota, enzymes and key soil processes, and their sorption limits their biodegradation.

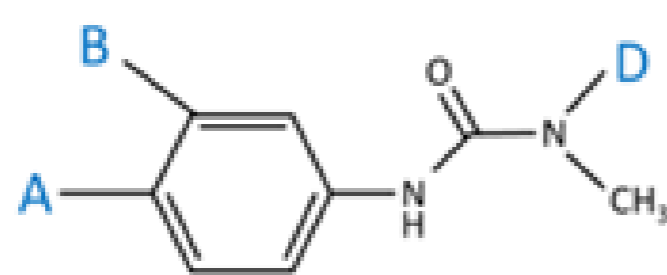


**Microbial biodegradation:** the main removal pathway, driven by the compound's bioaccessibility.

### AIM

Evaluate the potential of *Advenella sp.* JRO (AFQG01000022) to degrade other widely used phenylurea herbicides: chlorotoluron, isoproturon, fluometuron, and linuron.

## METHOD



IUPAC name	A	B	D	Chemical formula	Molecular mass (g mol <sup>-1</sup> )
<b>Chlorotoluron</b> 3-(3-chloro-ptolyl)-1,1-dimethylurea	CH <sub>3</sub>	Cl	CH <sub>3</sub>	C <sub>10</sub> H <sub>13</sub> ClN <sub>2</sub> O	212,68
<b>Fluometuron</b> 1,1-dimethyl-3-(α,α,α-trifluoro-m-tolyl)urea	H	CF <sub>3</sub>	CH <sub>3</sub>	C <sub>10</sub> H <sub>11</sub> F <sub>3</sub> N <sub>2</sub> O	232,2
<b>Isoproturon</b> 3-(4-isopropylphenyl)-1,1-dimethylurea		H	CH <sub>3</sub>	C <sub>12</sub> H <sub>19</sub> N <sub>2</sub> O	206,28
<b>Linuron</b> 3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea	Cl	Cl	OCH <sub>3</sub>	C <sub>9</sub> H <sub>10</sub> Cl <sub>2</sub> N <sub>2</sub> O <sub>2</sub>	249,09

## BIODEGRADATION SOLUTIONS ESSAYS



10 mg/L  
Chlorotoluron



10 mg/L  
Isoproturon



10 mg/L  
Fluometuron



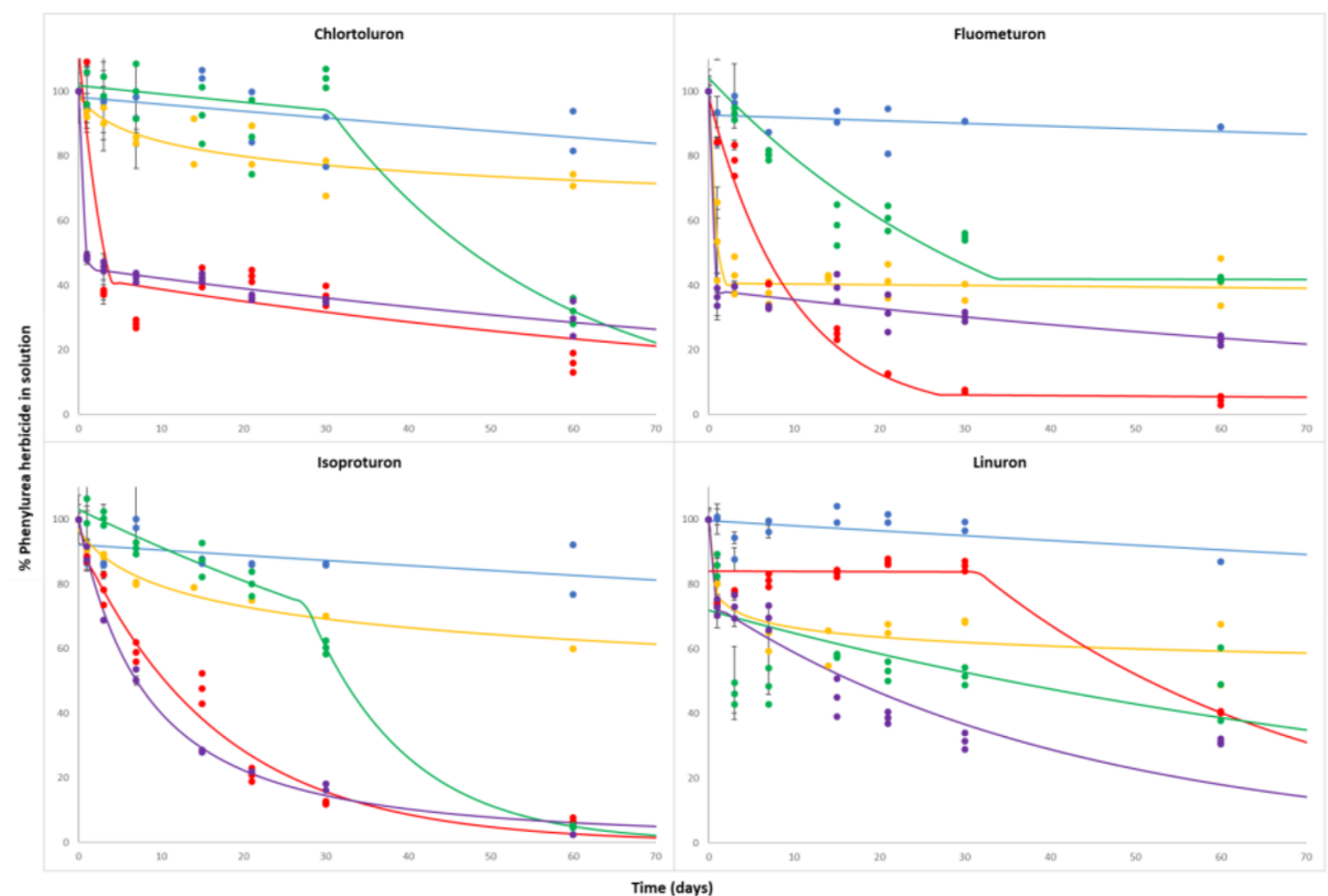
10 mg/L  
Linuron

### TREATMENTS

- **Bacteria strain:** *Advenella sp.* JRO (AFQG01000022)
- **Couple of bacteria strain:**  
*Advenella sp.* JRO (AFQG01000022) and *Arthrobacter sp.* N2 (AF235091)  
*Advenella sp.* JRO (AFQG01000022) and *Variovorax sp.* SRS16 (DQ432053)
- **Bacteria consortium:** *Advenella sp.* JRO (AFQG01000022) *Arthrobacter sp.* N2 (AF235091) and *Variovorax sp.* SRS16 (DQ432053)
- **Control**

Constant agitation at 20° C  
Ageing times: 1, 3, 7, 15, 21, 30 and 60 days

## RESULTS & DISCUSSION



— Control  
— *Advenella sp.* JRO  
— *Advenella sp.* JRO + *Variovorax sp.* SRS16  
— *Advenella sp.* JRO + *Arthrobacter sp.* N2  
— Bacterial consortium

*Advenella sp.* JRO showed limited degradation (28–59%), while its combination with *Variovorax sp.* SRS16 and *Arthrobacter sp.* N2 markedly enhanced removal, reaching up to 98% and DT<sub>50</sub> ≤ 7 days.

	Chlorotoluron		Isoproturon		Fluometuron		Linuron	
	DT <sub>50</sub> (days)	Extent of degradation (%)	DT <sub>50</sub> (days)	Extent of degradation (%)	DT <sub>50</sub> (days)	Extent of degradation (%)	DT <sub>50</sub> (days)	Extent of degradation (%)
<b>Control</b>	308	12.25	393	15.54	734	11.00	438	13.00
<b><i>Advenella sp.</i> JRO</b>	3636	27.45	342	40.00	1	59.04	833	42.00
<b><i>Advenella sp.</i> JRO + <i>V. sp.</i> SRS16</b>	3	83.95	11	93.61	7	95.65	58	59.61
<b><i>Advenella sp.</i> JRO + <i>A. sp.</i> N2</b>	47	67.90	32	95.04	26	58.05	67	51.00
<b>Bacterial Consortium</b>	1	70.30	7	97.70	1	77.08	17	68.71

## CONCLUSION

- This study demonstrates the ability of *Advenella sp.* JRO to degrade chlorotoluron, fluometuron, isoproturon, and linuron.
- The engineered consortium formed with *Arthrobacter sp.* N2 and *Variovorax sp.* SRS16 represents a promising strategy for improving bioaugmentation protocols aimed at the bioremediation of soils contaminated with phenylurea herbicides.

## FUTURE WORK / REFERENCES

Herbicides metabolites analysis will be conducted

Lara-Moreno et al., 2022. Abiotic and Biological Technologies for the Remediation of Phenylurea Herbicides in Soils. Hdb Env Chem 113, 317–352. [https://doi.org/10.1007/698\\_2021\\_799](https://doi.org/10.1007/698_2021_799)