DEGRADATION OF GLYPHOSATE BY A MICROBIAL COMMUNITY ISOLATED FROM AN AGRICULTURAL SOIL TREATED WITH THE HERBICIDE

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Introduction. Some herbicides, such as glyphosate (systemic compound through the phloem mobility) and paraquat (a contact herbicide), can be adsorbed by the plant through the aerial parts. When they are applied after emergency, activity can be detected from soil to the roots. Thus, these herbicides persist in the environment, resulting in their incorporation to terrestrial and aquatic ecosystems. For this reason, it is important to offer alternatives for the biological removal of these xenobiotics. The aim of this work is the selection of microorganisms able to degrade glyphosate.

Methods. The microbial community was selected from soil samples, using three selection techniques: 1) chemostat (suspended cells) 2) Packed-bed micro-columns (biofilm formation) and 3) hydrogel beads (biofilm formation). Once selected the community, the evaluation of glyphosate removal was made in a batch culture with the microbial community immobilized in volcanic rock. During selection and evaluation of the community, glyphosate was quantified by the ninhydrin test and HPLC. Identification of the microorganisms was performed by the 16S rDNA gene sequencing method.

Results. Agricultural soil samples from Santa Catarina, Tlaxcala that were treated with the commercial herbicide FAENA (36% glyphosate), were used for microbial selection. Three enrichment methods were tested (Table 1).

Table 1 Comparison of screening methods

Enrichment method	Species (bacteria)	Community designation	Removal rate of glyphosate (mg/Ld)	Removal efficiency (%)
Chemostat	2	GQ	5.87	47
Micro-column	1	GM	0.30	52
Hydrogel beads	4	GP	10.87	87

Because GP community showed the highest removal rate and efficiency of the herbicide, it was selected. The results in Figure 1 show that the GP community uses glyphosate as carbon, nitrogen and phosphorus sources.

The results obtained with both analytical methods, HPLC and ninhydrin, showed minimal differences. By HPLC, accumulation of intermediates was not observed, and the glyphosate removal efficiency remained at 87%.

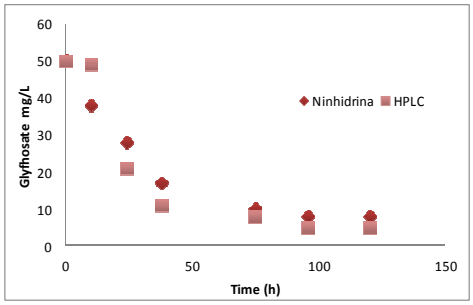

Figure 1 Determination of glyphosate degradation by the GP community in batch culture. Two methods were used; ninhydrin and HPLC

The cultivable bacterial strains identified in the GP community are shown in Table 2.

Table 2 16S rDNA homology of microorganisms comprising the selected community

Strain	NCBI accession number	Sequence Homology	Microorganism
A	NC_015125.1	97 %	*Microbacterium testaceum*
B	NC_009659.1	80 %	*Janthinobacterium sp*
C	NC_010725.1	93 %	*Methylobacterium populi*
D	NC_009659.1	94 %	*Janthinobacterium sp*

Conclusions:
The community selected by methods favoring the enrichment of biofilm-forming bacteria show the highest removal efficiencies.
The microbial community GP had the highest removal efficiency (87%) and removal volumetric rate of glyphosate in batch culture (11.25 mg glyphosate/Ld).

References:
Baylis, AD., 2000. Why glyphosate is a global herbicide: strengths, weaknesses and prospects. Pest Management Science 56, 299-308.