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Bioavailability and ecotoxicity of pentachlorophenol in agricultural soils: effects of organic fertilization

• Pentachlorophenol (PCP) is a broad-spectrum pesticide, to be very toxic and it is classified in the priority list of organic micropollutants because of its carcinogenicity and toxicity. Organic contaminants such as PCP have been traditionally studied with exhaustive extraction techniques aimed to a complete recovery. However, this approach doesn't take in account that only a fraction of contaminants, i.e., the bioavailable fraction, comes in contact with living organisms and thus represents a real risk.

• Organic fertilizers such as compost are widely used in order to restore soil fertility. In presence of contaminants compost may enhance microbial degradation, but little is known on its effect on bioavailability processes.

• Aim of this work is to evaluate bioavailability and degradation of PCP in sterilized and non sterilized agricultural soils after organic fertilization, and to assess the ecotoxicological effect of the bioavailable fraction of PCP by means of a luminescent biosensor.

INTRODUCTION

EXPERIMENTAL SECTION

Chemical analyses: exhaustive extraction with water:ethanol (1:1, v:v); non exhaustive extraction (bioavailable fraction) with water. PCP quantification by HPLC.

Biological analyses: application of the luminescent biosensor *Pseudomonas fluorescens* pUCD607.

All experiments carried out in sterilized (ST) and non sterilized (NST) conditions

Analysis carried out at 0, 20, 60 and 120 days from contamination

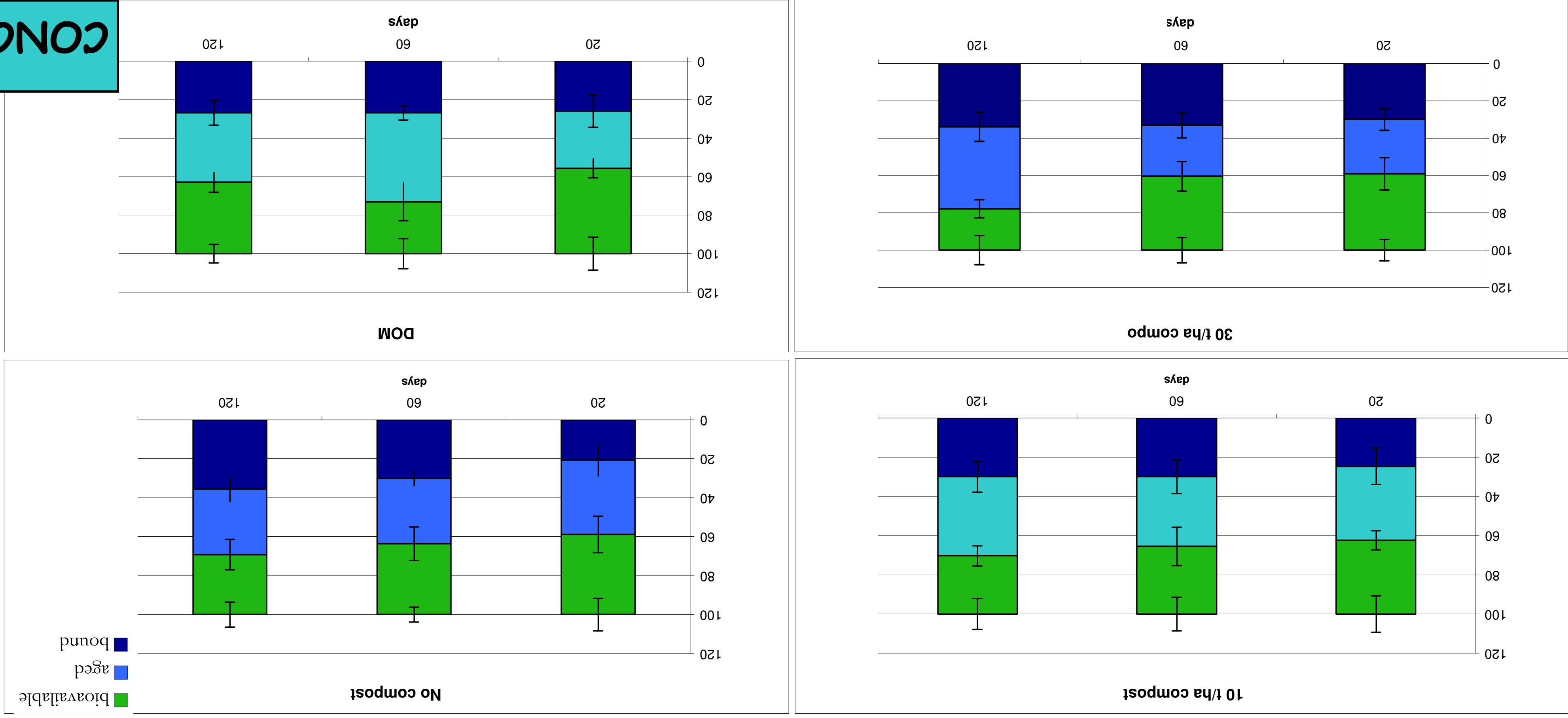
RESULTS

STERILE CONDITIONS

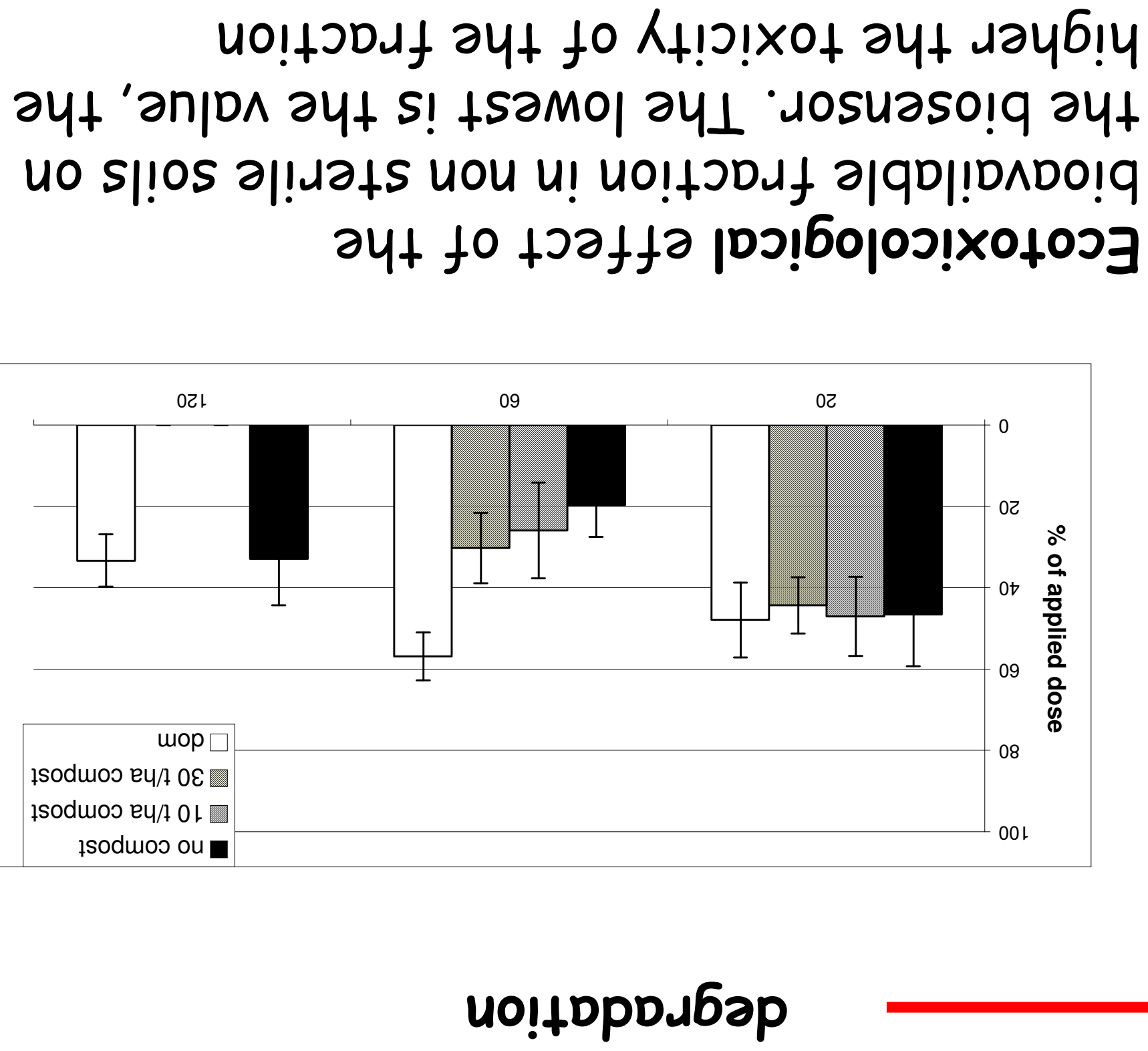
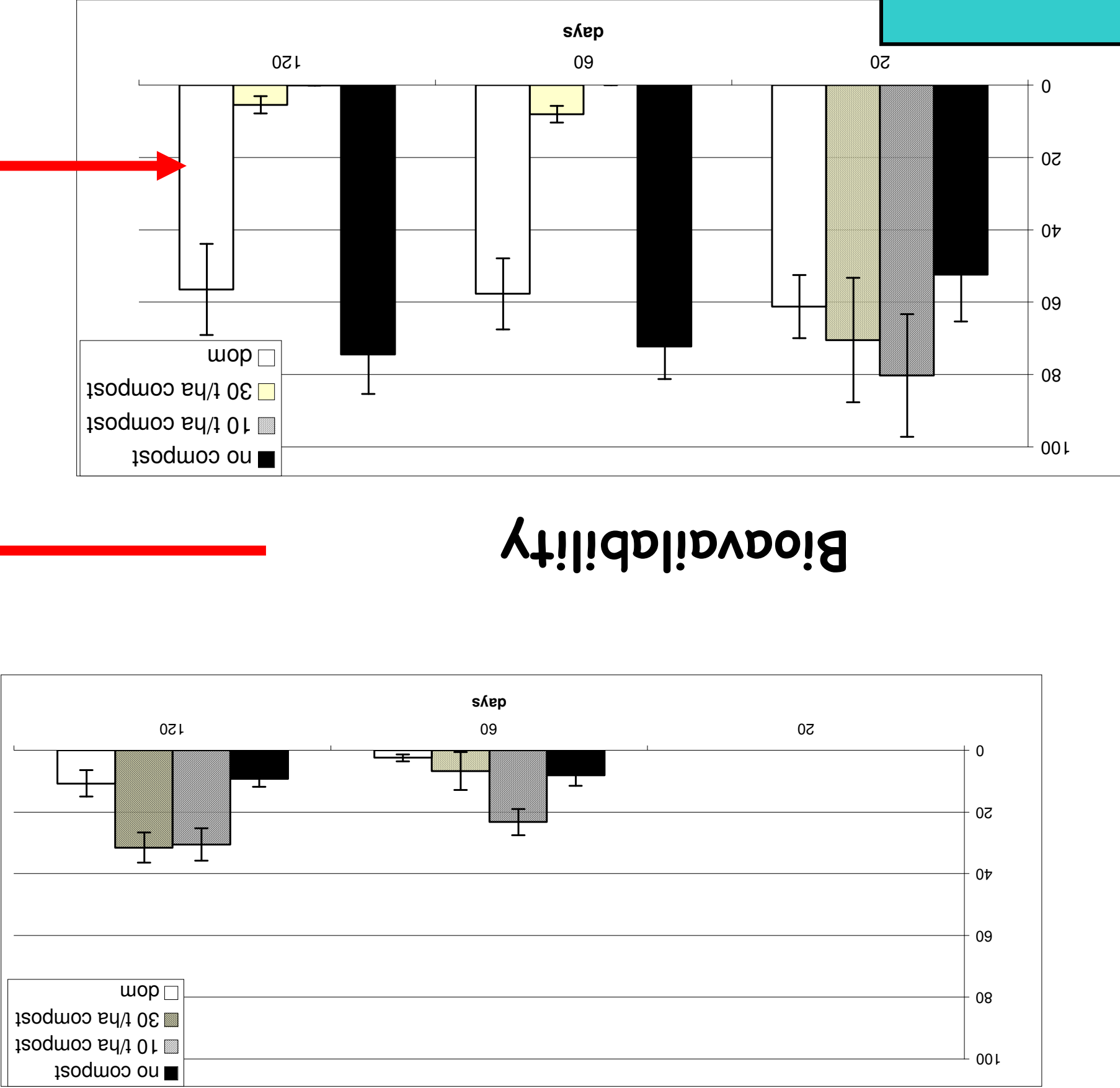
- non amended
 - amended with 10 t/ha of compost
 - amended with 30 t/ha of compost
 - amended with DOM
- Red soils (terre rosse) from South Italy were spiked in the lab with 150 mg/kg of PCP.
- Experimental treatments (3 replicates each):

Definitions for the assessment of PCP in different fractions in sterile conditions:

- **Bound** = 1 - fraction extracted with exhaustive technique in sterile soils
- **Bioavailable** = fraction extracted with non-exhaustive technique in sterile soils
- **Aged** = fraction extracted with exhaustive - fraction extracted with non-exhaustive technique in sterile soils



CONCLUSIONS



- Bioavailability of PCP in sterile conditions at 20 days after contamination is already reduced to the 40% of the applied dose. Bioavailability of PCP is furthermore reduced in the later samplings, especially in the compost amended soils.
- In non sterile, realistic conditions, compost reduces the impact of PCP by reducing its bioavailability and enhancing its degradation. In particular, in the two compost amended soils no PCP is still available at 120 days from contamination.
- In the compost amended soils, where degradation was enhanced, higher ecotoxicity effects were detected. Since the toxicity of chlorophenols is usually proportional to the degree of chlorination, this could be due to the release of toxic compounds already present in the compost. Further experiments are now being carried out to investigate this hypothesis.

