# RELATIONSHIP BETWEEN SOIL MICROBIAL BIOMASS METHODS USED IN ENVIRONMENTAL FATE STUDIES

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## INTRODUCTION

### BACKGROUND

- **Determination of microbial biomass activity is requisite for certain OECD studies.**
- Microbial biomass activity is measured prior, during and after a study.
- **Two common methods are referenced in the OECD guidelines (i.e. OECD 307).**
- These are the fumigation extraction method and the substrate induced respiration method.
- **Fumigation extraction method:**
- Soil is fumigated with chloroform, which causes cellular lysis. This ultimately results in a flush of nutrients into the soil environment.
- The difference in the soil organic carbon content between soil that is fumigated and soil that is not fumigated is indicative of the size of the soil microbial biomass.
- **Substrate induced respiration method:**
- Microbial respiration is induced by amending the soil with glucose.
- The amount of carbon dioxide produced or oxygen consumed is measured and used to calculate a respiration rate, which is indicative of the size of the microbial community.
- **Despite both methods being recognised, they reflect different aspects of the soil microbial community.**
- One fundamental difference is whether they can potentially distinguish between active and non-active components of the biomass.
- Taking this difference into account, it is important to consider which method is more appropriate for the determination of soil suitability for environmental fate studies.

### AIMS

- To investigate the relationship between soil microbial methodologies.
- To better understand how the choice of method relates to soil suitability for environmental fate studies.



OECD 307 Aerobic Transformation in Soil Study

## MATERIALS AND METHODS

### SOILS

- 10 different soil were selected, their properties are outlined below:

| | Particle Size (%) USDA | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Soil code | Sand | Silt | Clay | Textural Class | WHC*1(%) | OC*2(%) | OM*3(%) | pH*4 |
| A | 69 | 26 | 5 | Sandy Loam | 66 | 1.6 | 2.7 | 7.2 |
| B | 65 | 23 | 12 | Sandy Loam | 45 | 1.0 | 1.7 | 7.6 |
| C | 59 | 30 | 11 | Sandy Loam | 42 | 1.0 | 1.7 | 7.3 |
| D | 52 | 35 | 13 | Sandy Loam | 41 | 0.5 | 0.9 | 7.7 |
| E | 23 | 54 | 23 | Silt Loam | 69 | 3.5 | 6.0 | 5.5 |
| F | 18 | 58 | 24 | Silt Loam | 73 | 3.8 | 6.6 | 5.5 |
| G | 35 | 34 | 31 | Clay Loam | 43 | 0.7 | 1.2 | 6.7 |
| H | 32 | 41 | 27 | Clay Loam | 45 | 2.0 | 3.4 | 7.4 |
| I | 49 | 34 | 17 | Loam | 61 | 1.9 | 3.3 | 4.7 |
| J | 29 | 48 | 23 | Loam | 79 | 2.0 | 3.5 | 6.3 |

*1 – Maximum Water Holding Capacity
*2 – Organic Carbon
*3 – Organic Matter
*4 – pH determined in 0.01 M $CaCl_2$

### SUBSTRATE INDUCED RESPIRATION AND FUMIGATION EXTRACTION

- Fumigation extraction was performed by fumigating a subsample of soil with ethanol free chloroform for 24 hours. Organic carbon was extracted using 0.5 M potassium sulphate and was measured using a Sievers Innov0x TOC analyser.
- Substrate induced respiration was performed by measuring pressure reduction manometrically in sealed systems for 12 hours. The lowest glucose concentration that yielded the maximum initial respiratory response was determined. This method was repeated in triplicate using the determined glucose concentration.

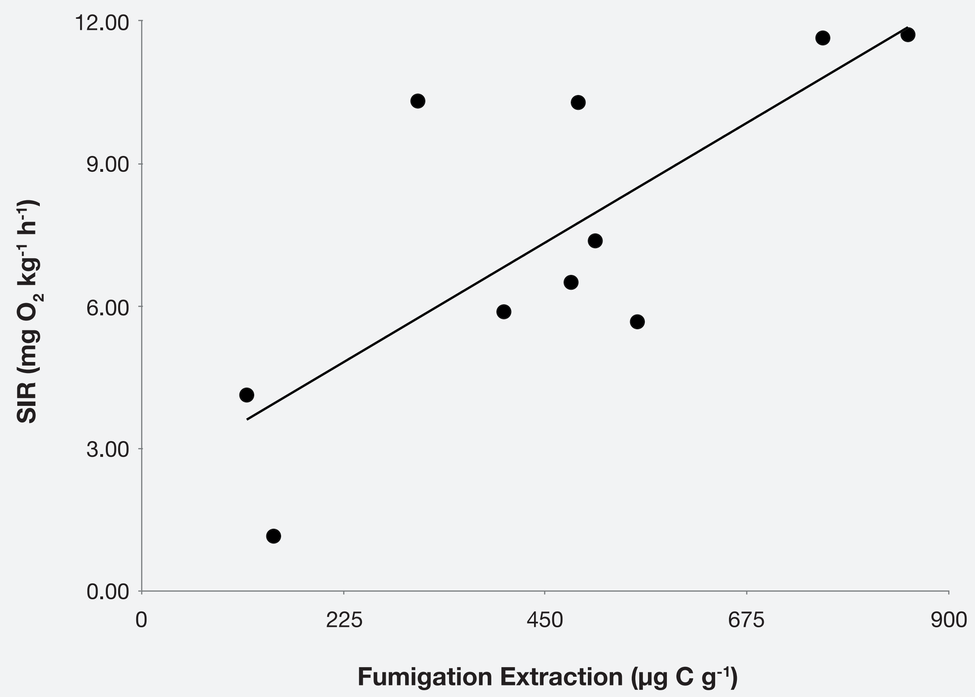




## RESULTS AND DISCUSSION

### SUBSTRATE INDUCED RESPIRATION VS FUMIGATION EXTRACTION

- A **positive relationship** between microbial biomass carbon (fumigation extraction) and substrate induced respiration (SIR) was observed (Linear Regression analysis: Adjusted R2 = 0.52, R 2.12.2, R Core Team, Austria).




| Soil code | Substrate Induced Respiration (mg $O_2$ $kg^{-1}$ $h^{-1}$) | Fumigation Extraction (µg C $g^{-1}$) |
|---|---|---|
| A | 6.50 | 479 |
| B | 10.31 | 308 |
| C | 10.28 | 487 |
| D | 1.16 | 147 |
| E | 5.67 | 553 |
| F | 11.71 | 855 |
| G | 4.13 | 117 |
| H | 11.64 | 760 |
| I | 5.88 | 404 |
| J | 7.37 | 506 |

- However, the **moderate correlation** of the linear regression model indicates that microbial activity may not be completely related to microbial biomass size. This may ultimately indicate that the soils tested vary in their proportions of active and non-active biomass, which could affect their perceived suitability for an environmental fate study.

## CONCLUSIONS

This work indicates that for certain soils, the choice of method may affect the perceived suitability of a soil for environmental fate studies. More work is being conducted at Smithers Viscient to investigate this relationship more thoroughly.

## ACKNOWLEDGEMENTS

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