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University of Saskatchewan

Carbon dioxide as an indicator of 2,4-D degradation in a biobed mix

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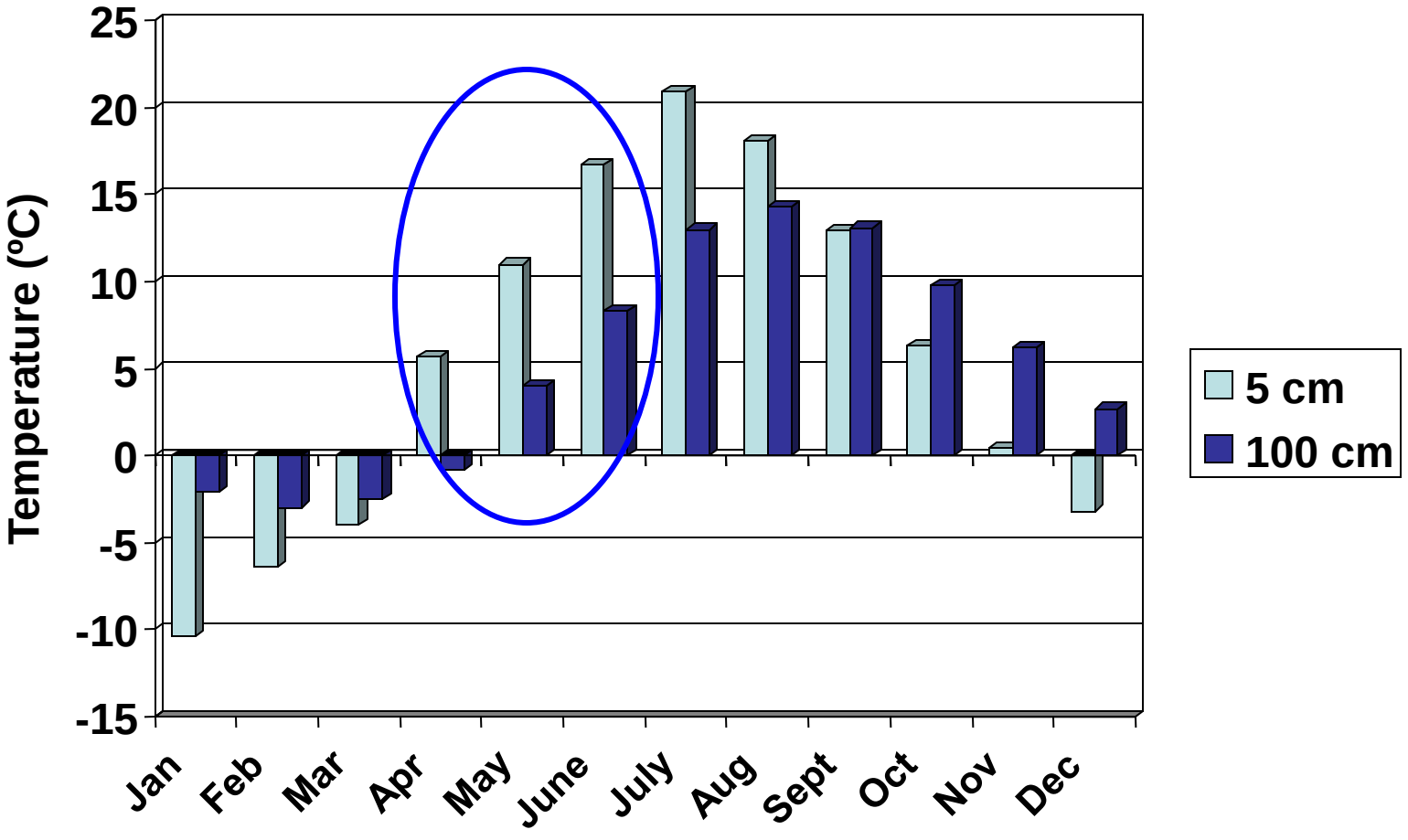
Canada

Introduction

- About 45 million kg a.i. sold per year in Canada;
- Saskatchewan province uses about 36% of all pesticides in Canada;
- Pesticides found in surface and sub-surface water;
- Regulations for waste disposal are difficult to follow or enforce.

Monthly Soil Temperatures in Saskatoon



Current research

- Laboratory studies at 5 ºC, 13 ºC and 20 ºC for the following pesticides:
  - 2,4-D
  - Bromoxynil
  - Pyrasulfotole
  - Thiencarbazone
  - Thifensulfuron-methyl
  - Tribenuron-methyl
  - Metsulfuron-methyl

- Pending analysis

Thermo gradient plate

Objective

- Study the degradation of 2,4-D in a biobed mix and soil by monitoring carbon dioxide emission.

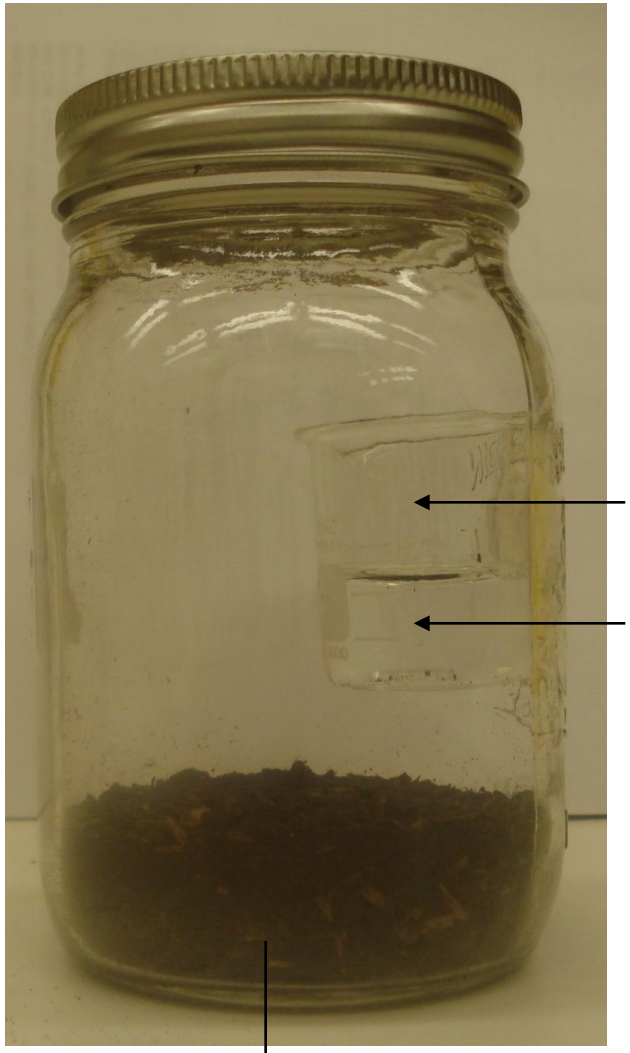
Materials & Methods

- **Biomix composition**
- Clay-loam topsoil, compost and chopped wheat straw (1:1:2 v/v/v)

- **Topsoil**
- Same as used in biomix

Laboratory Experiment 1 - single application

- 35g DW Biobed mix or Topsoil
- 18.2 mg a.i 2,4-D amine
- Moisture:
  - biobed mix 46% of field capacity
  - soil 28% of field capacity
- CO_2 captured in 0.2M KOH
- Titration with 0.1M HCL
- Calculation of captured CO_2



Laboratory Experiment 2 - repeated applications

- 50g DW Biobed mix and Topsoil
- 26 mg a.i 2,4-D per application (5 times)
- Moisture:
  - biobed mix 46% of field capacity
  - soil 23% of field capacity
- CO_2 captured neutralised with 0.5M HCL
- Calculation of captured CO_2

50g DW Biomix or Soil 10mL 0.1M KOH

µg (CO_2) evolved/g sample/day =(((B-V)*N*E)*1000µg/mg)/g sample/ 2 days

Where:

V= titre (mL) to reach neutralization

B= titre (mL) required to reach blank endpoint

N= Normality of the HCl titrant

E= 22 (Equivalent weight of CO_2)

Extraction of 2,4-D

35g or 50g DW biobed mix or soil in 250 mL glass bottle

↓

100 or 150 mL extraction solvent (water, acetonitrile, acetic acid)

↓

Shake for 1 hour

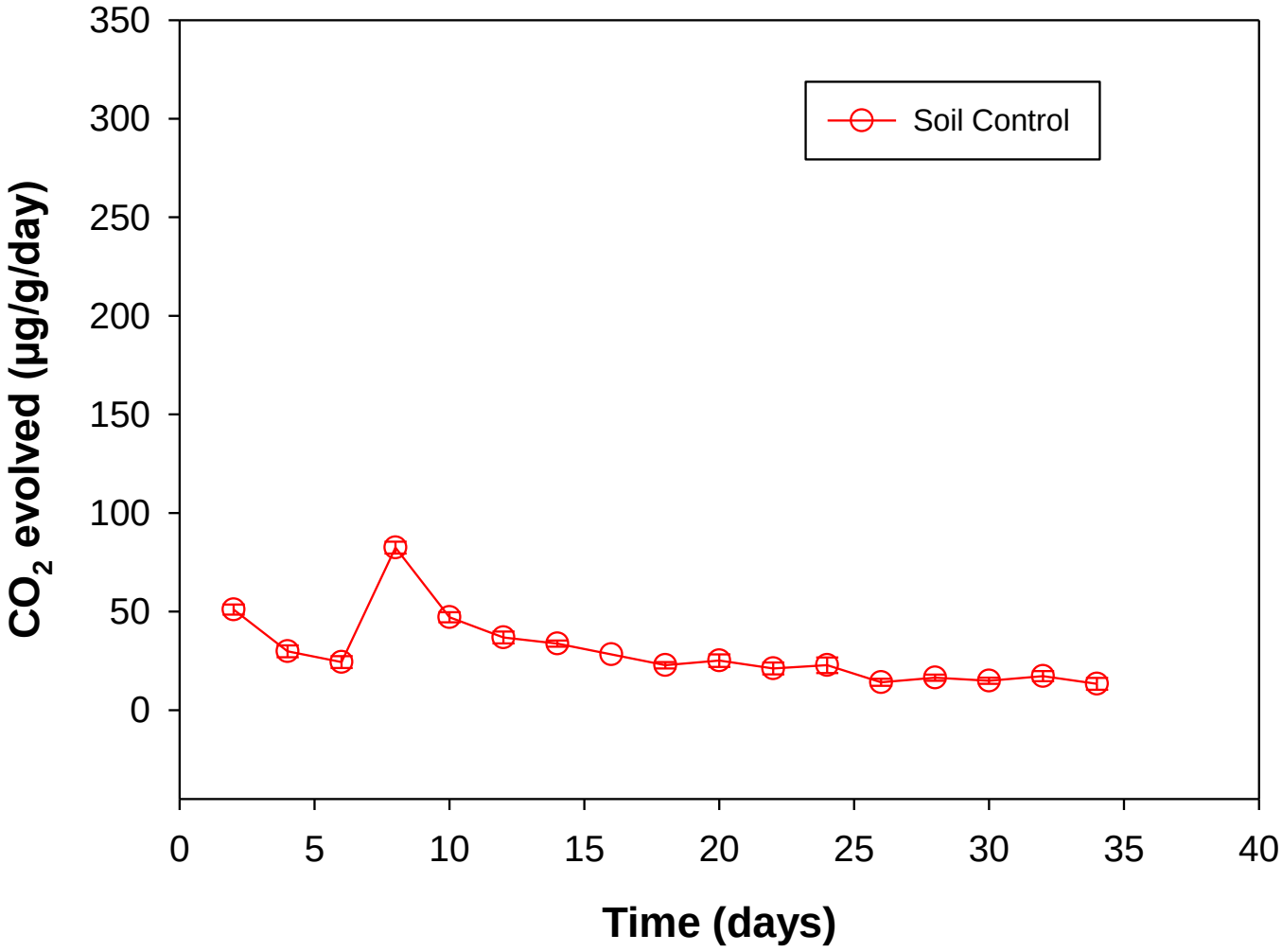
↓

Filter

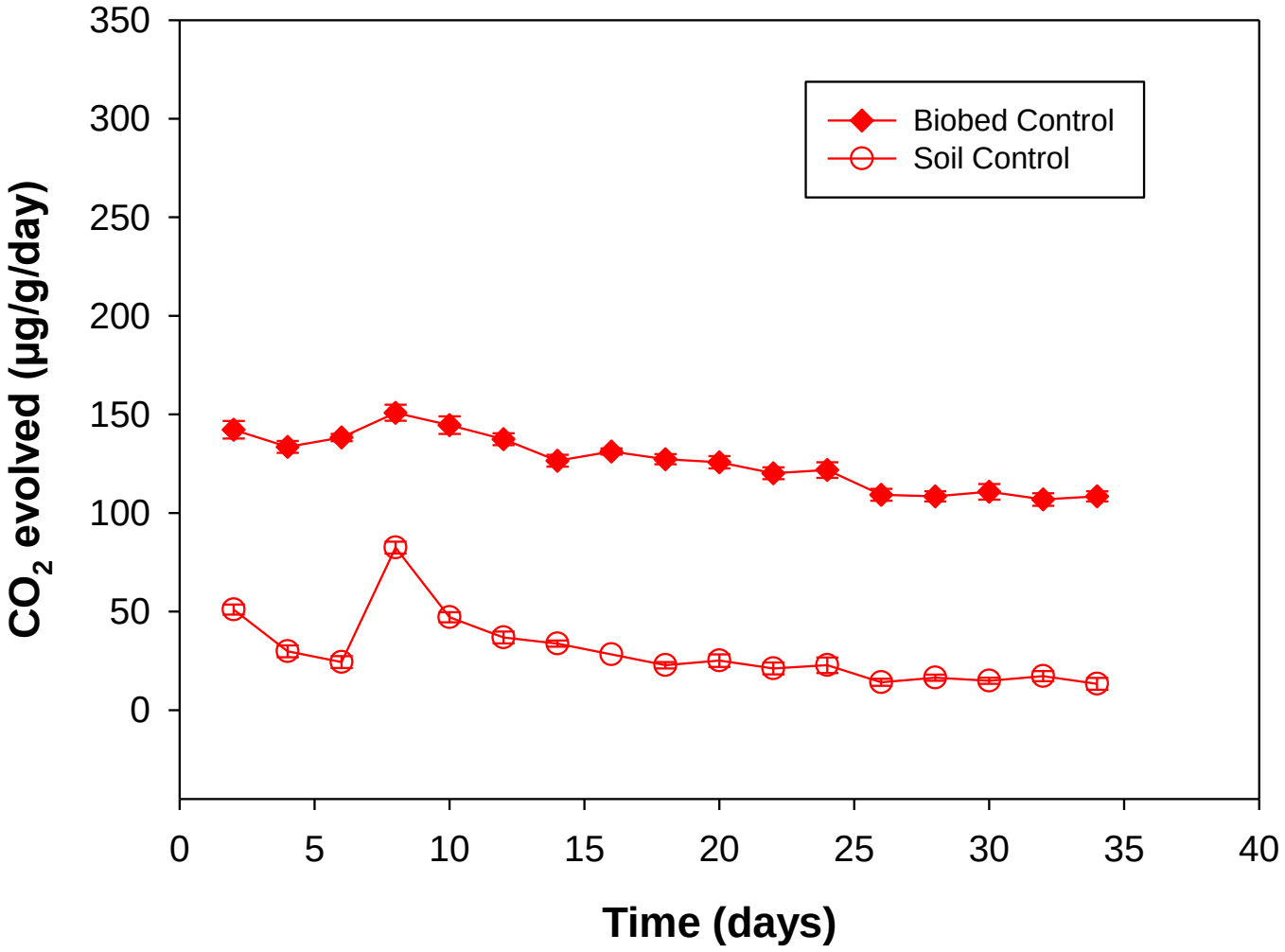
↓

HPLC analysis

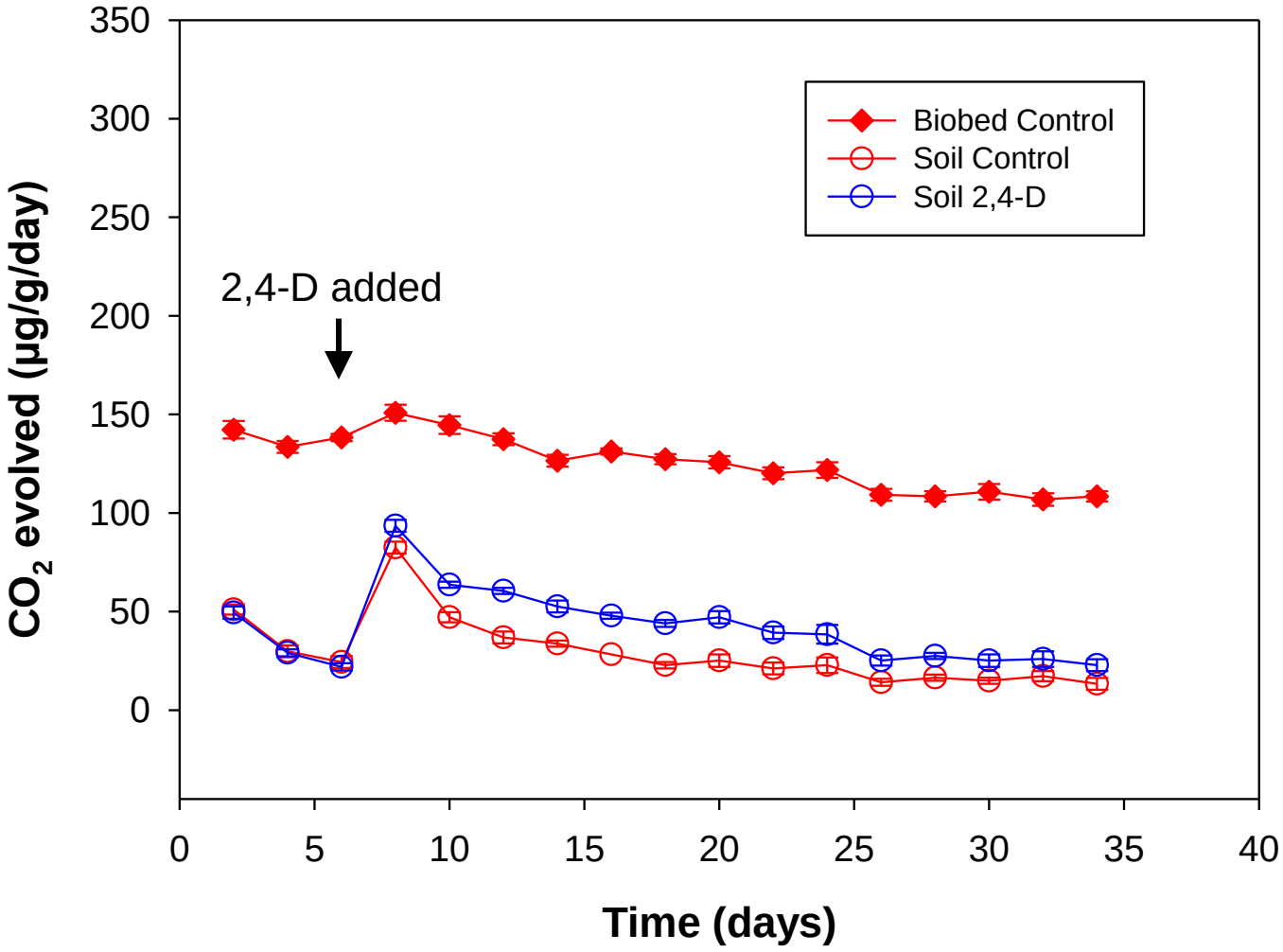
Single 2,4-D Application



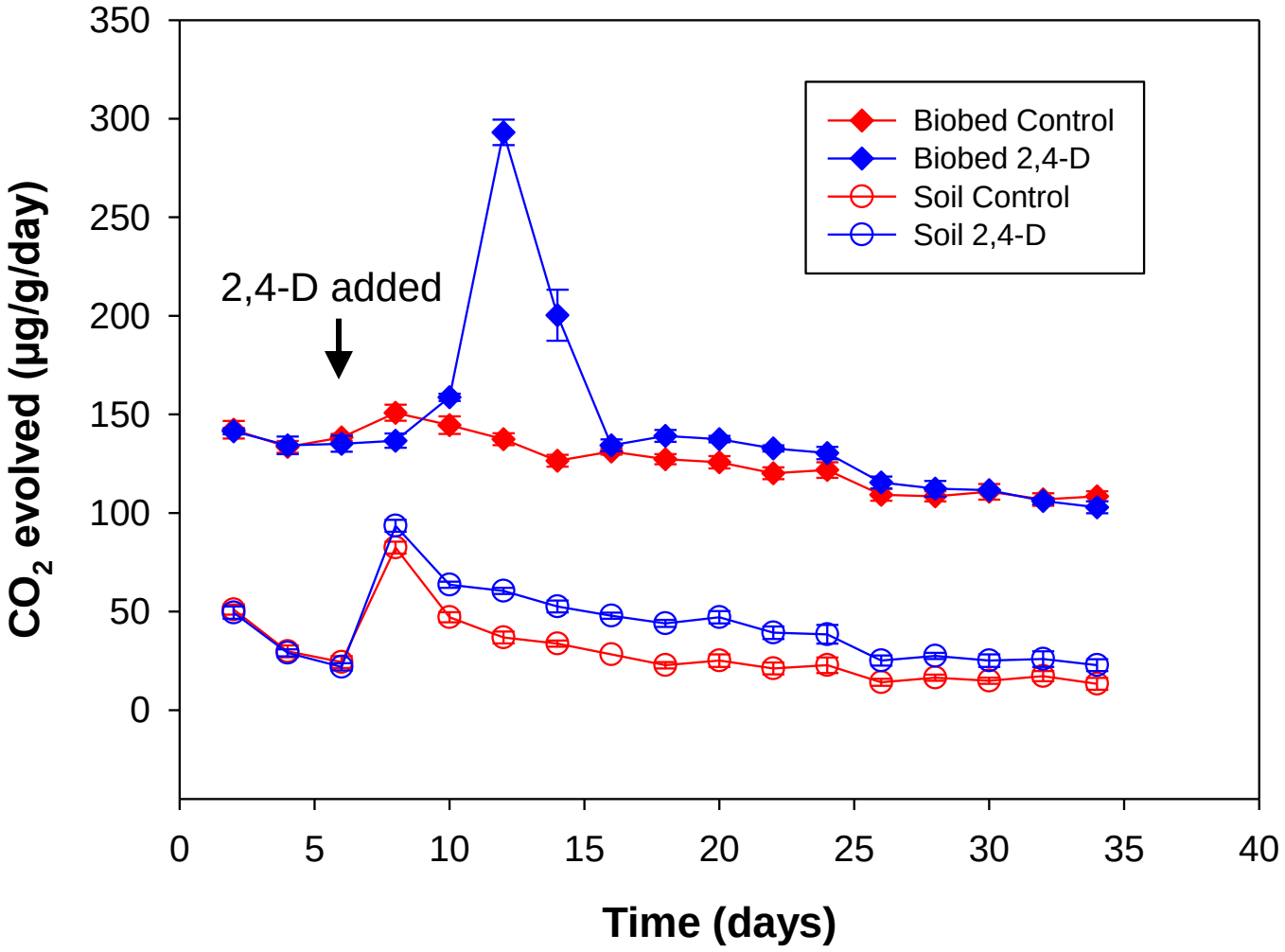
Single 2,4-D Application



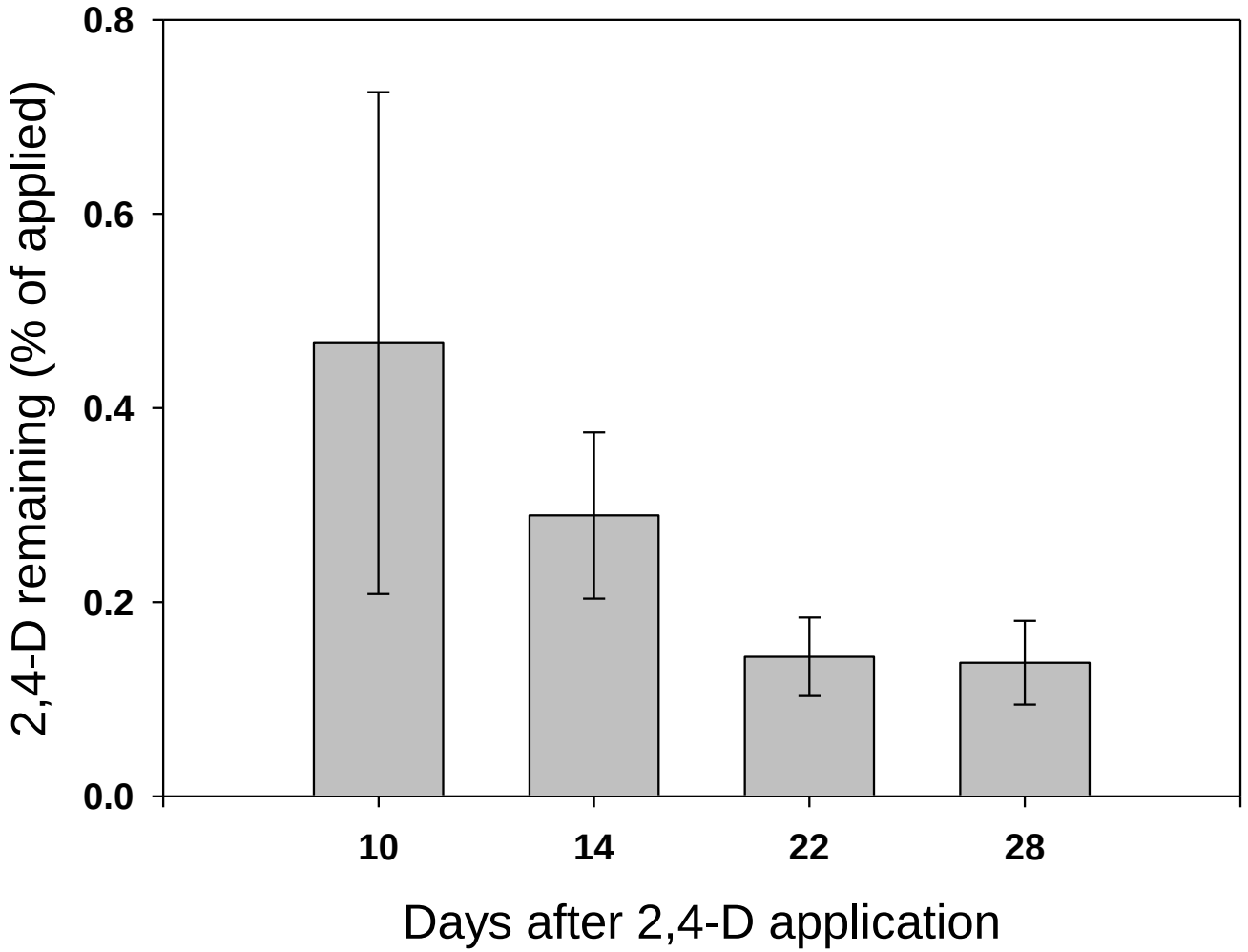
Single 2,4-D Application



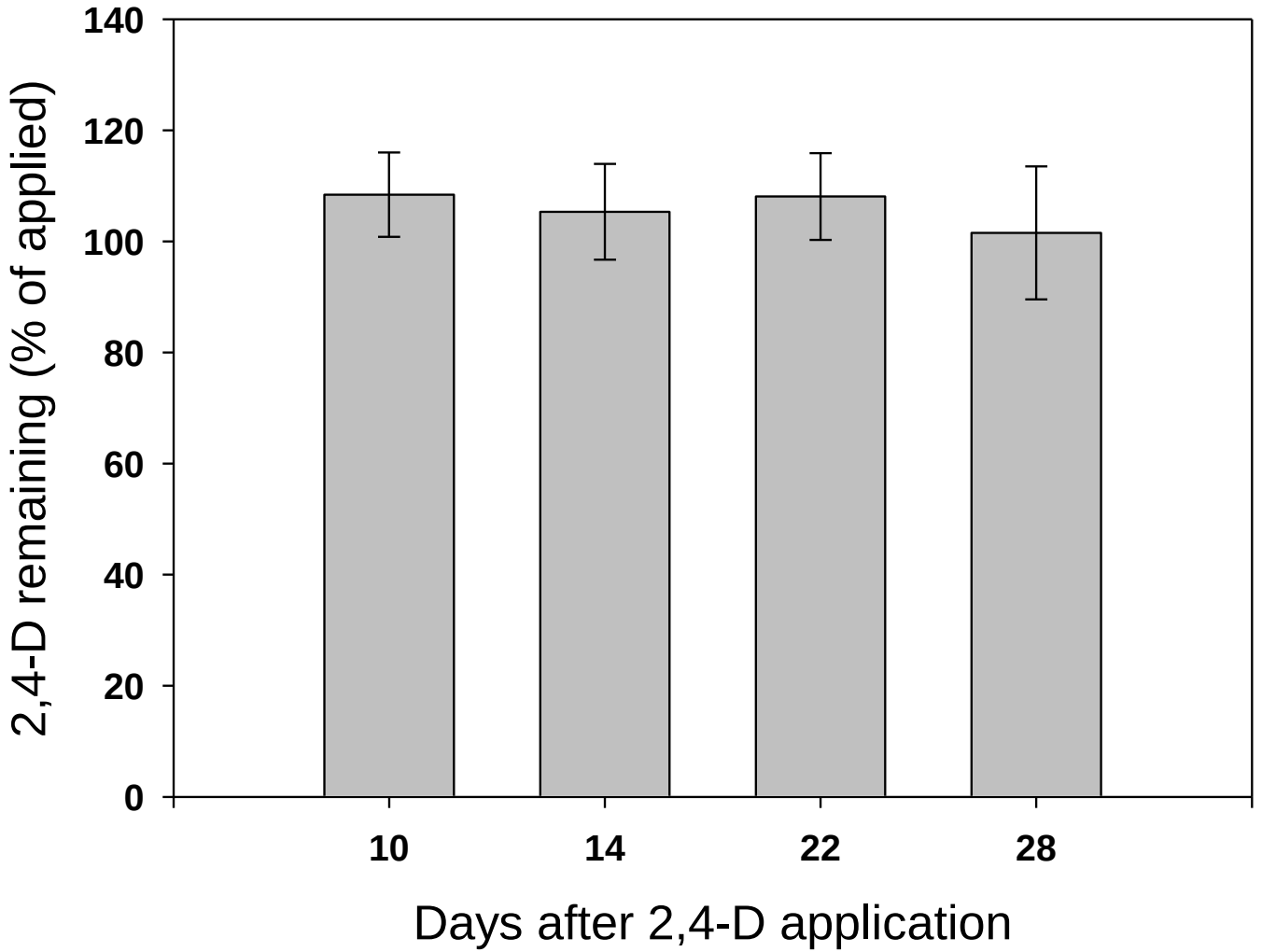
Single 2,4-D Application



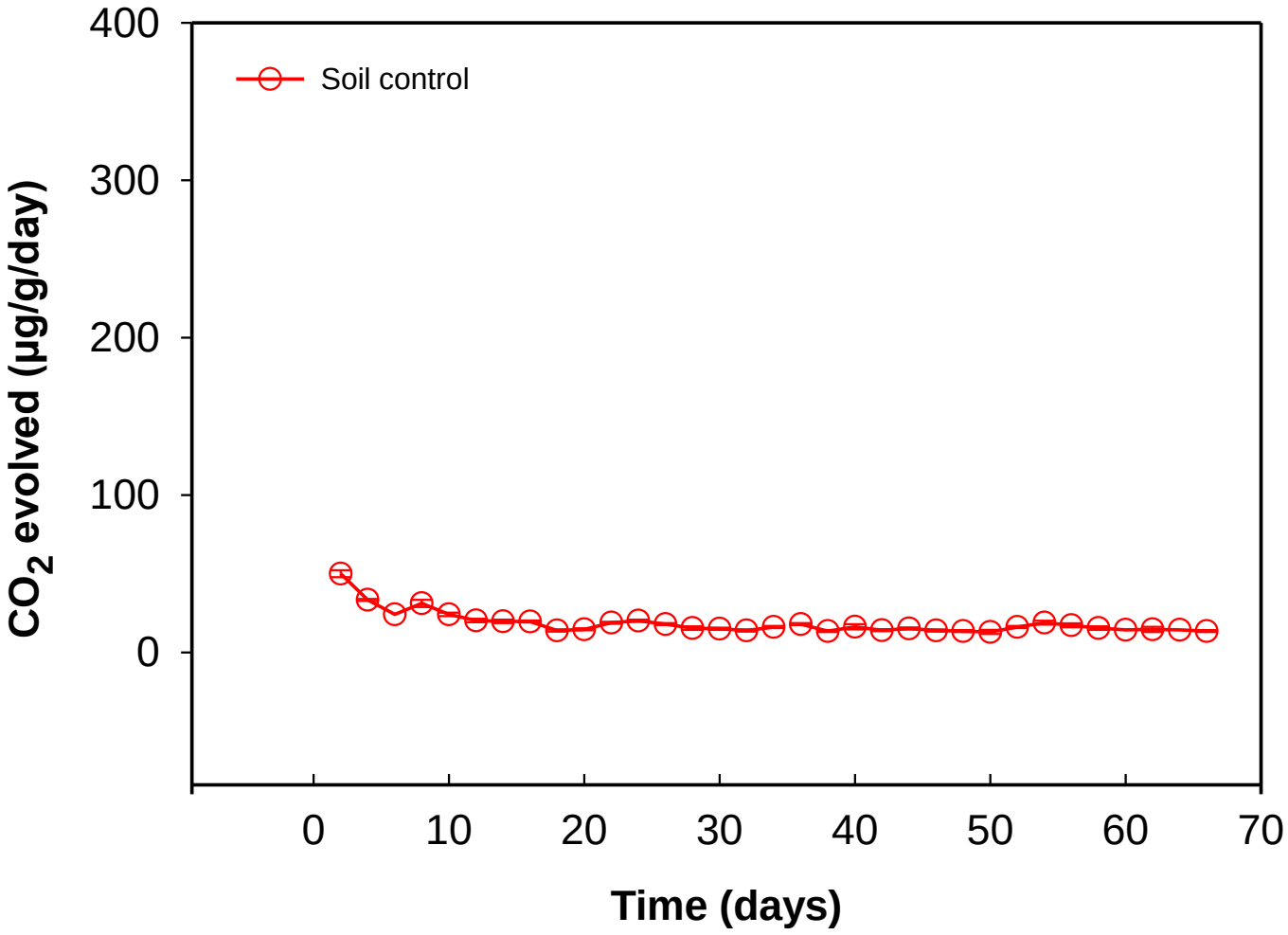
Biomix: Percent of applied 2,4-D remaining



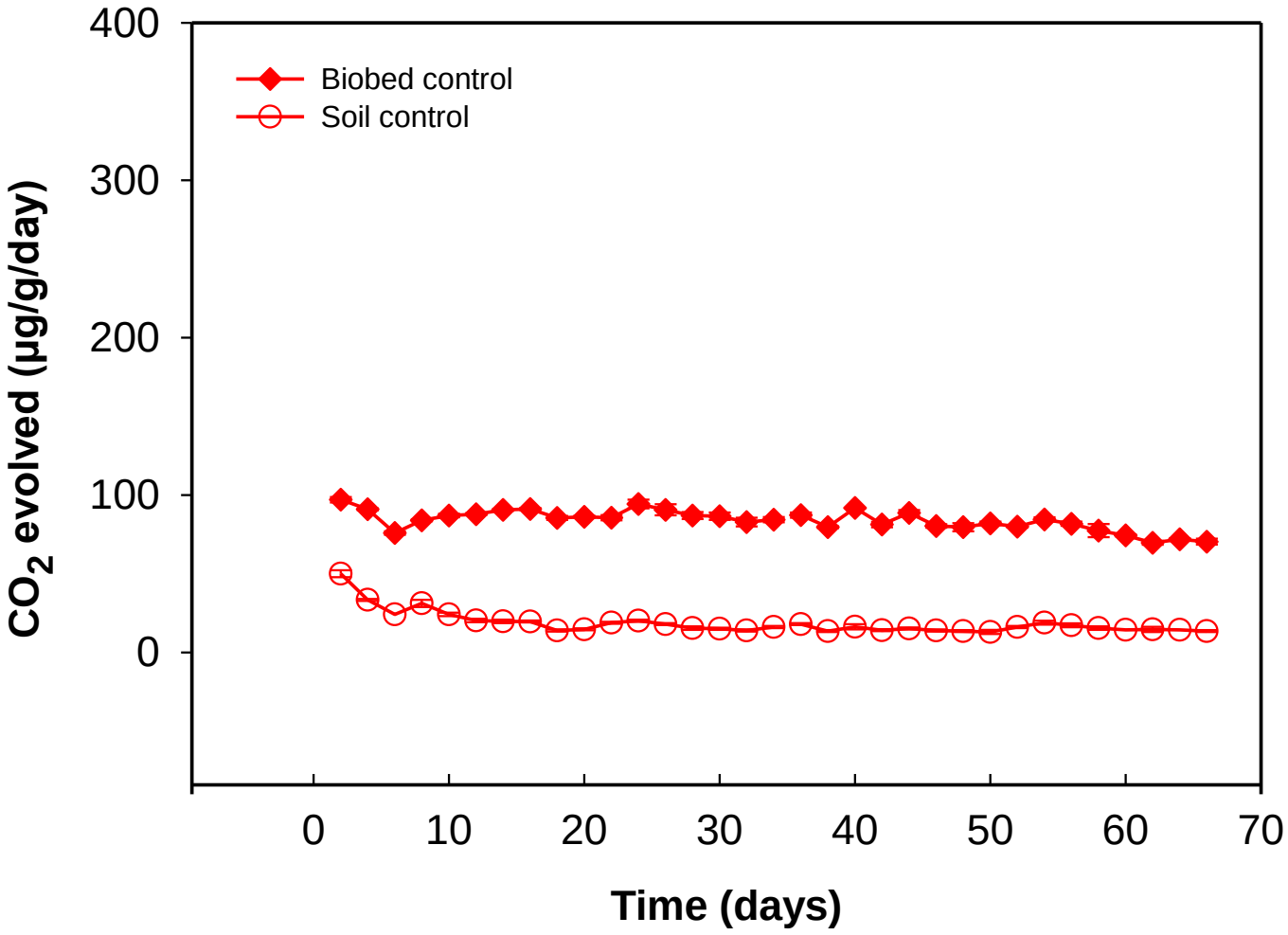
Soil: Percent of applied 2,4-D remaining



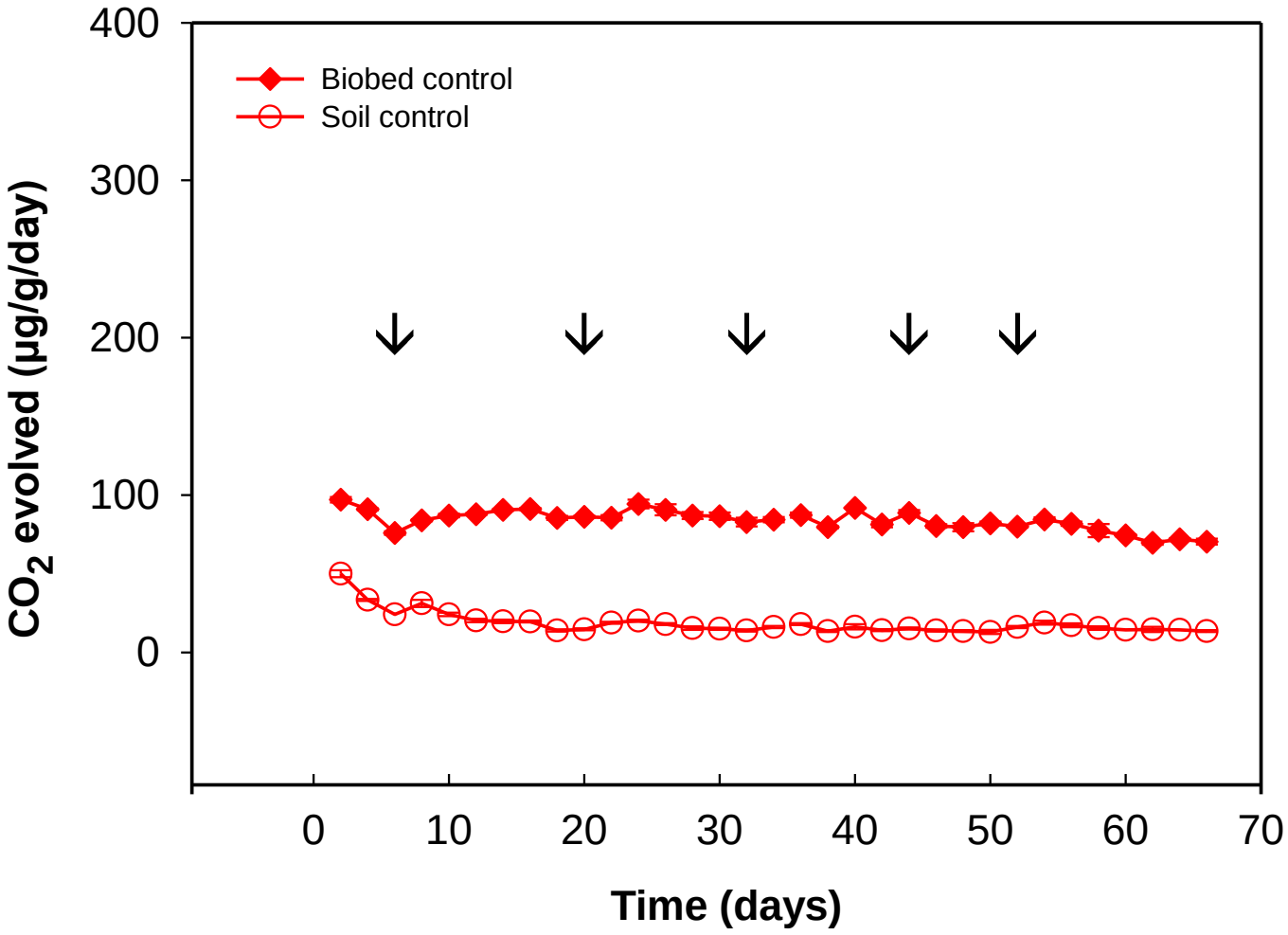
Multiple 2,4-D Application



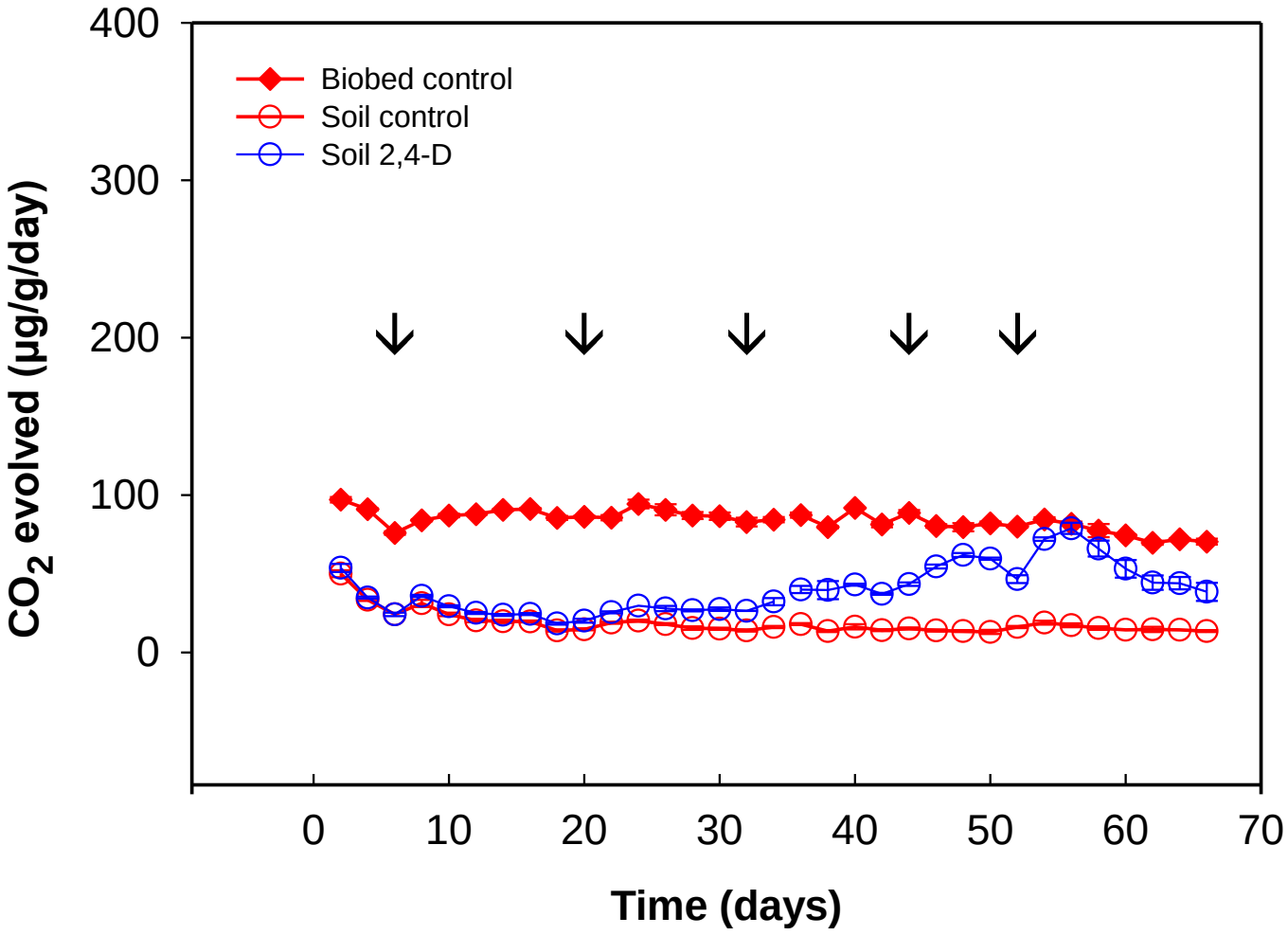
Multiple 2,4-D Application



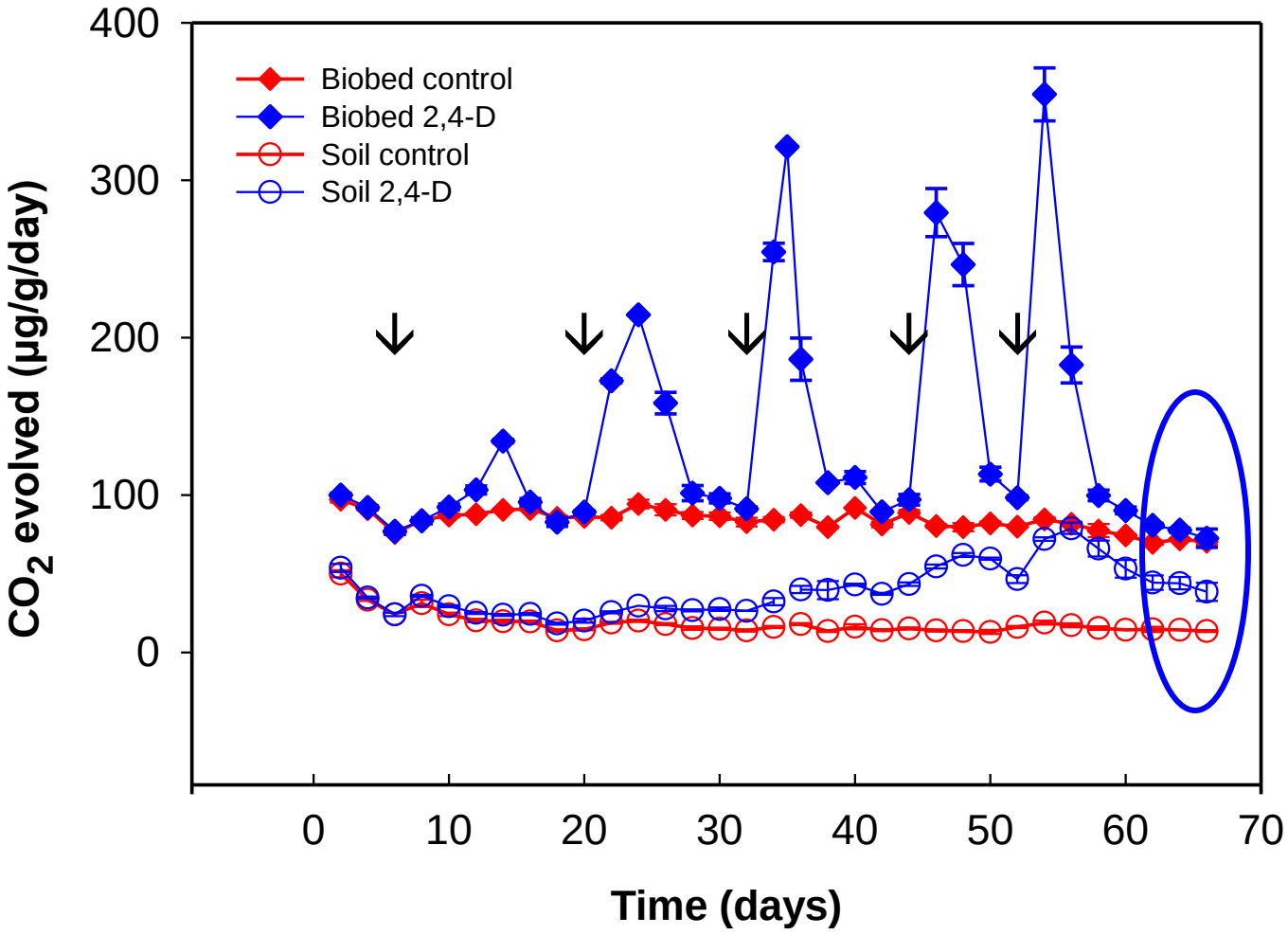
Multiple 2,4-D Application



Multiple 2,4-D Application



Multiple 2,4-D Application



2,4-D remaining

Substrate	% 2,4-D Remaining
Biomix	0.029
Soil	69.700

Conclusions

- Rapid degradation of 2,4-D in a biobed mix (>99%) in 10 days;
- No significant degradation in soil within same time period;
- CO_2 evolution lagged several days after initial application
- Subsequent applications to the same substrate showed an immediate increase;
- Carbon dioxide emission maybe an indication of 2,4-D breakdown in this study.

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