CONTRIBUTION OF RYEGRASS TO THE CO_2 EMISSION FROM CULTIVATED PEAT SOILS IN SWEDEN – A LYSIMETER EXPERIMENT

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Conclusions

- **The plant-derived contribution was 28-68% of total CO_2 emission from peat soil**
- **The contribution of rhizosphere induced CO_2 emission to total soil CO_2 emission is large, and differ between soil types**
- **It is important to know the plant-derived CO_2 flux, otherwise the overestimation of soil CO_2 emission can be considerable**
- **The root exclusion method can be used for estimation of plant-derived CO_2 emissions most of the season when the priming effect is negligible**

Introduction

With regard to the CO_2 driven greenhouse effect there is a need to distinguish between soil organic matter derived respiration and plant-derived respiration. Kuzyakov (2006) divides the total CO_2 efflux from soil into 5 sources (Figure 1). The aim of this investigation is to use the root exclusion method to divide total CO_2 emissions from the soil-plant system into soil emissions and plant-derived respiration, using lysimeters where the environmental parameters can be monitored and controlled.

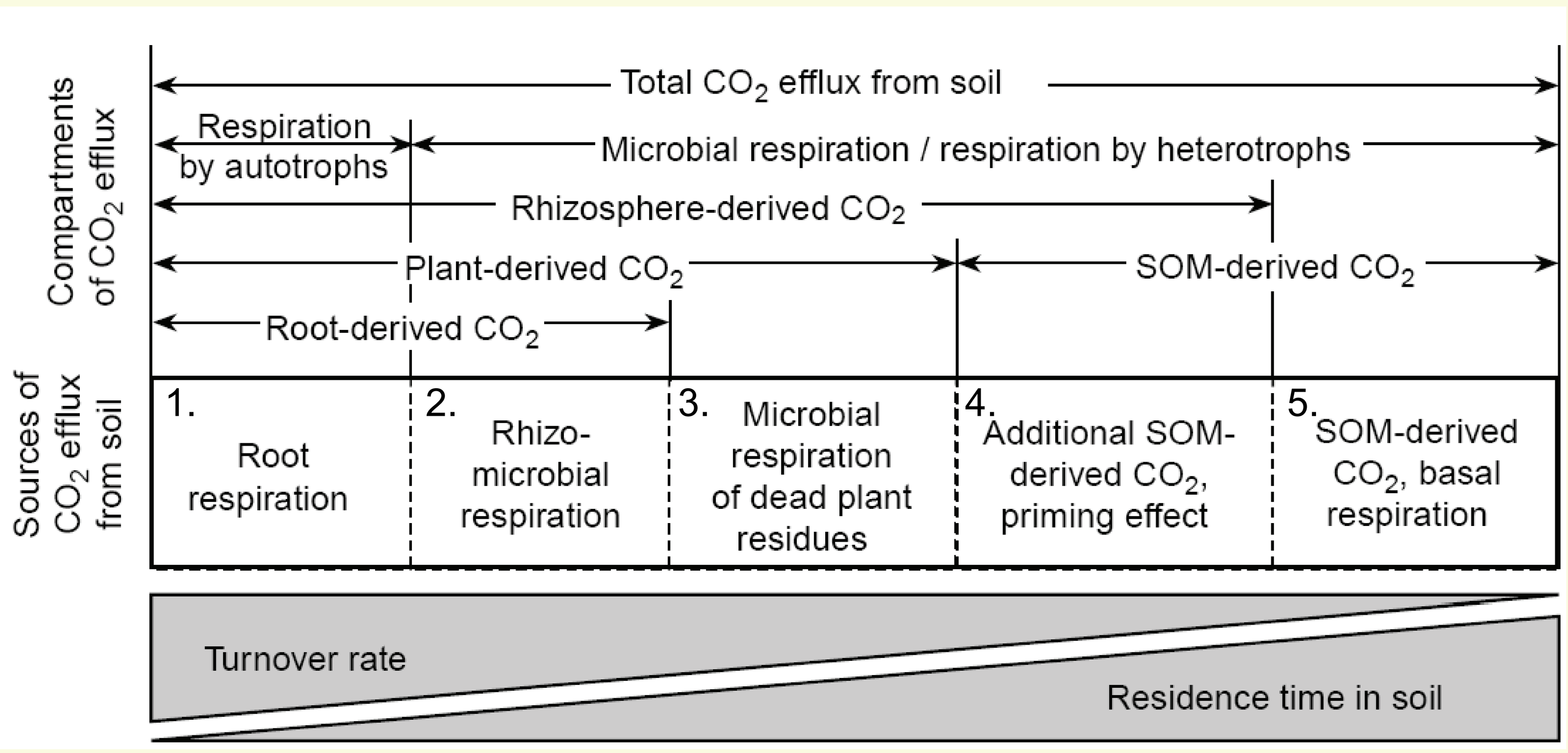
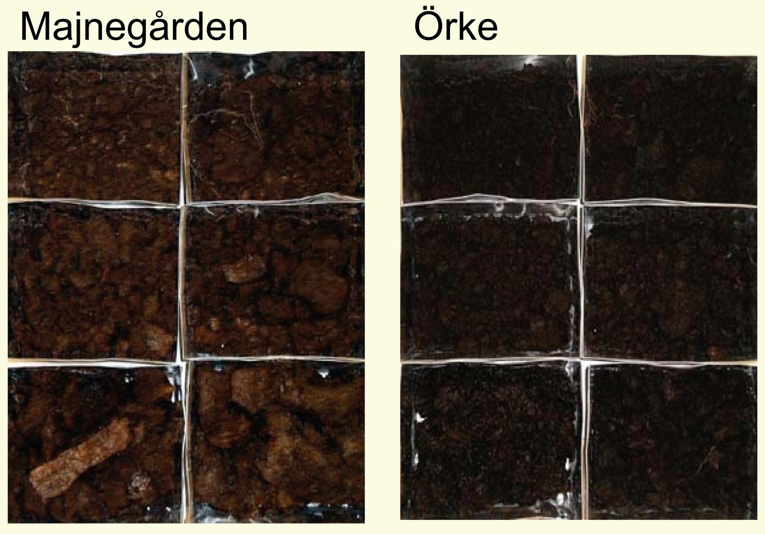


Figure 1. The first three sources can be considered plant-derived and the last two contribute to the greenhouse effect. With the root exclusion method it is possible to distinguish between basal respiration and the rhizosphere-derived respiration. This method can be used to estimate the net CO_2 emission if the priming effect (4) is small. Figure from Kuzyakov (2006).

Materials and methods

A drilling method with minimal soil disturbance (Persson and Bergström, 1991) was used to collect 50 cm deep undisturbed soil monoliths from two sites, Örke in central Sweden and Majnegården in southern Sweden. The study was carried out at a lysimeter site at the Agricultural University in Uppsala. The lysimeters were sown with ryegrass (*Lolium perenne*) and water was supplied from below and kept constant at 40 cm depth. The construction and set-up of this system is described in detail in Berglund et al. (2007).



Results

CO_2 emissions rates from the lysimeters with crop were higher than from the lysimeters without crop (Figure 2).

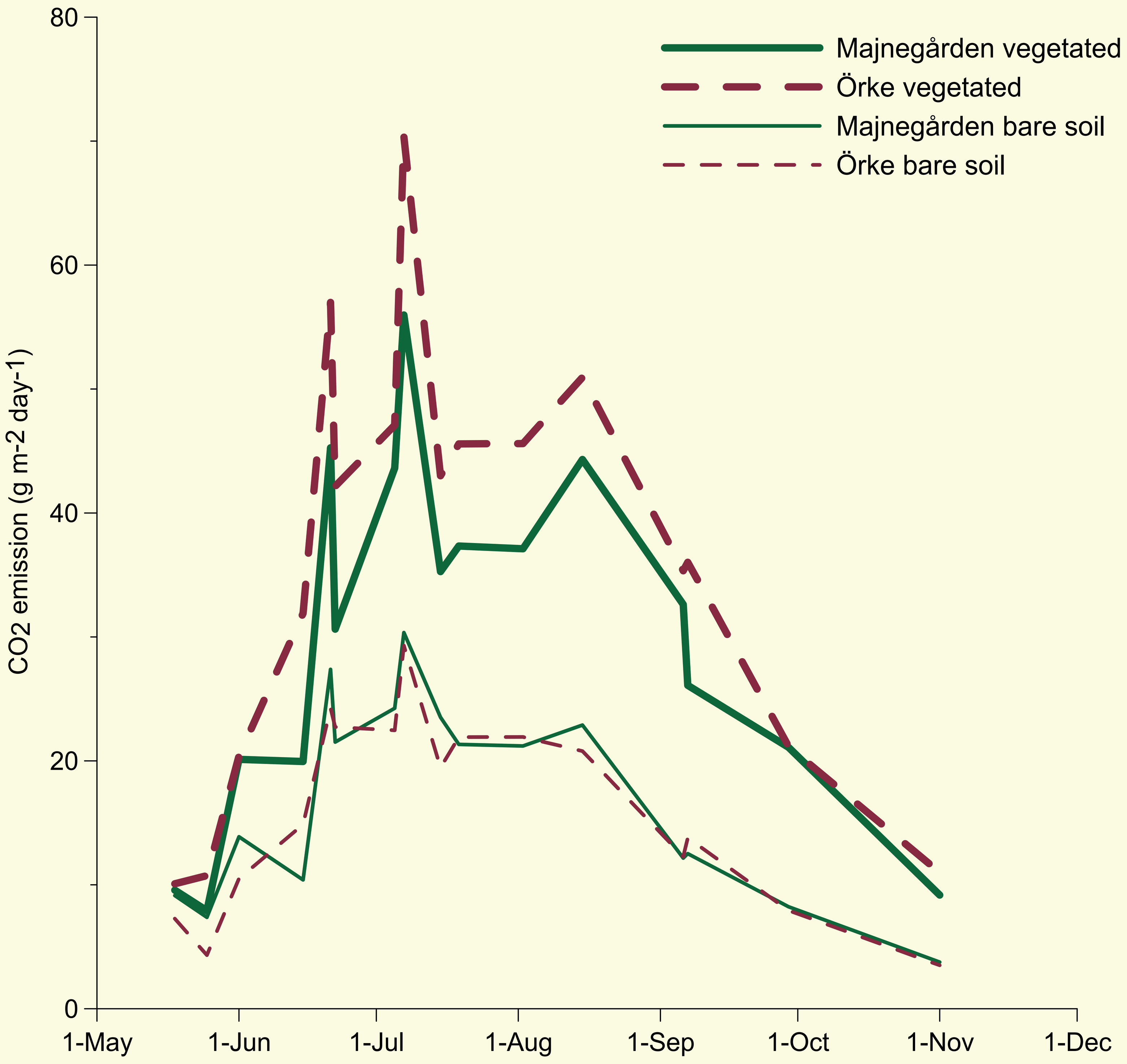


Figure 2. Total CO2 emission from two peat soil types (Majnegården and Örke), bare soil compared to vegetated.

To estimate the CO_2 emissions originating from plants we used the rhizosphere-derived contribution (RC) as an approximation (eq. 1).

$$RC = \frac{CO_2 WithCrop - CO_2 BareSoil}{CO_2 WithCrop} \qquad \text{eq.1}$$

The RC was always higher from Örke than from Majnegården (Table 1), which might be attributed to differences in soil quality and/or crop production level.

Table 1. Rhizosphere-derived contribution (RC) to CO2 emissions from two peat soils types during three seasons

Site	18/5-30/6	5/7-9/8	15/8-1/11
Majnegården	0.28	0.47	0.58
Örke	0.53	0.56	0.68

The rhizosphere-derived contribution to the CO_2 flux was increasing at the end of the season even though biomass production was declining. This is an indication of a lagging priming effect.

References

Berglund, Ö., Berglund, K. and Klemedtsson, L., 2007. A lysimeter study on the effect of temperature on CO2 emission from cultivated peat soils, Submitted to Geoderma. Swedish University of Agricultural Sciences, Department of Soil Sciences, Uppsala, pp. 1-18.

Kuzyakov, Y., 2006. Sources of CO2 efflux from soil and review of partitioning methods. Soil Biology & Biochemistry, 38(3): 425-448.

Persson, L. and Bergström, L., 1991. Drilling method for collection of undisturbed soil monoliths. Soil Science Society of America Journal, 55(1): 285-287.

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