Agricultural Intensification: Impacts on Microarthropod Communities

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Introduction

- Microarthropods – soil and litter-dwelling arthropods ~2-0.1mm in size – are often the most dominant arthropod group in soils across ecosystems
- There is growing evidence that microarthropods, particularly springtails and oribatid mites, can exert strong impacts on soil organic carbon dynamics[1]
- In the annual cropping treatments at the KBS LTER Main Cropping System Experiment, the highest concentrations of surface soil carbon are associated with organic and no-till cropping systems[2]

Table 1. Soil carbon concentrations (g C kg soil^{-1}) in the A/Ap horizons (Syswerda et al., 2011)

Organic	No-Till	Reduced Input	Conventional
12.2(0.4)^{A}	> 11.5(0.4)^{A}	> 11.1(1.2)^{AB}	> 10.4(0.3)^{B}

- While agricultural intensification generally disfavors microarthropods, previous studies have shown that different types of management (i.e. tillage, fertilization, etc.) have varying impacts on microarthropods[3]

Hypothesis: Microarthropod abundance/diversity will be positively correlated with soil carbon concentration, with abundance/diversity greatest in no-till and organic, intermediate in reduced input, and least in conventional systems.

Methods

- Surveyed microarthropods from conventional, no-till, reduced input, and organic winter wheat at the KBS LTER in May, 2019 by taking 3 X 15cm soil cores and 25cm^2 litter quadrat samples
- Microarthropods were extracted from soil and litter via Tullgren funnels

Results

- Overall microarthropod abundance was far greater in litter versus soil
- In litter, microarthropods were most abundant in the No-till treatment
- In soil, microarthropods were most abundant in the Organic treatment
- The No-till system had the most litter per 25cm^2
- On a per gram of litter basis, microarthropods were more abundant in No-till, Reduced input and Organic treatments

Total Microarthropod Abundances in May, 2019

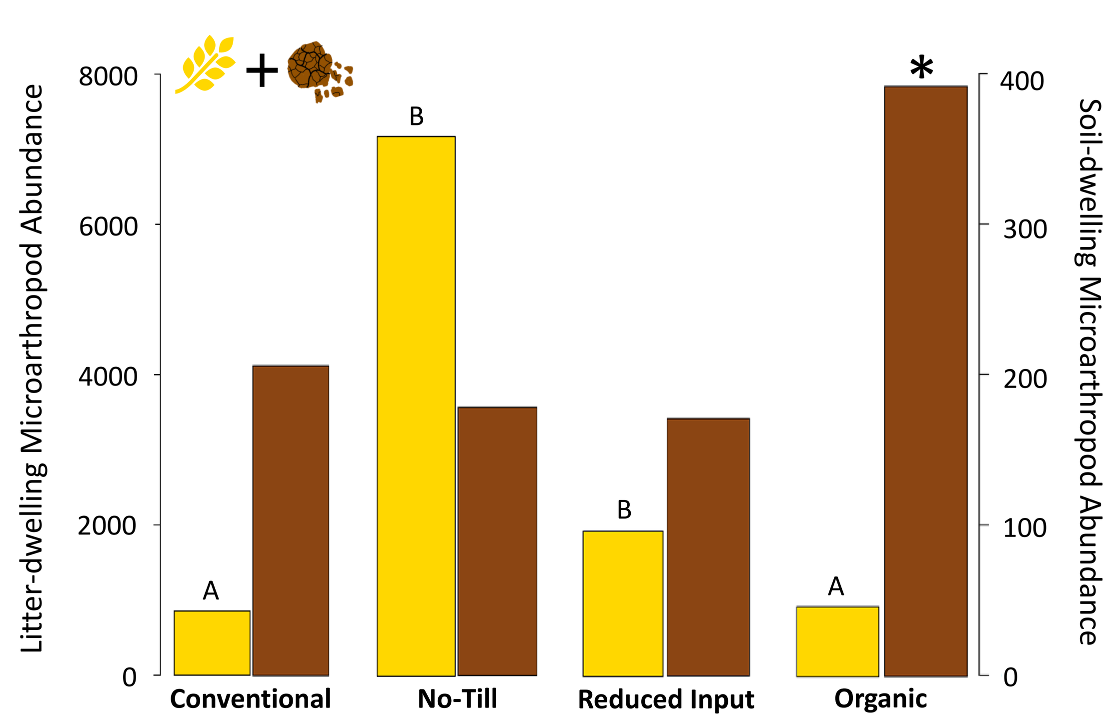

Fig 1. Total numbers of microarthropods collected from litter and soil core samples across wheat treatments. Brown bars indicate numbers of microarthropods collected from soil while gold bars indicate those collected from litter. Different letters (litter) or asterisks (soil) indicate significant differences (p ≤ 0.05).

- Microarthropod abundance varies strongly between soil and litter fractions & across management systems
- Microarthropod abundance in litter is higher in systems that are building soil carbon

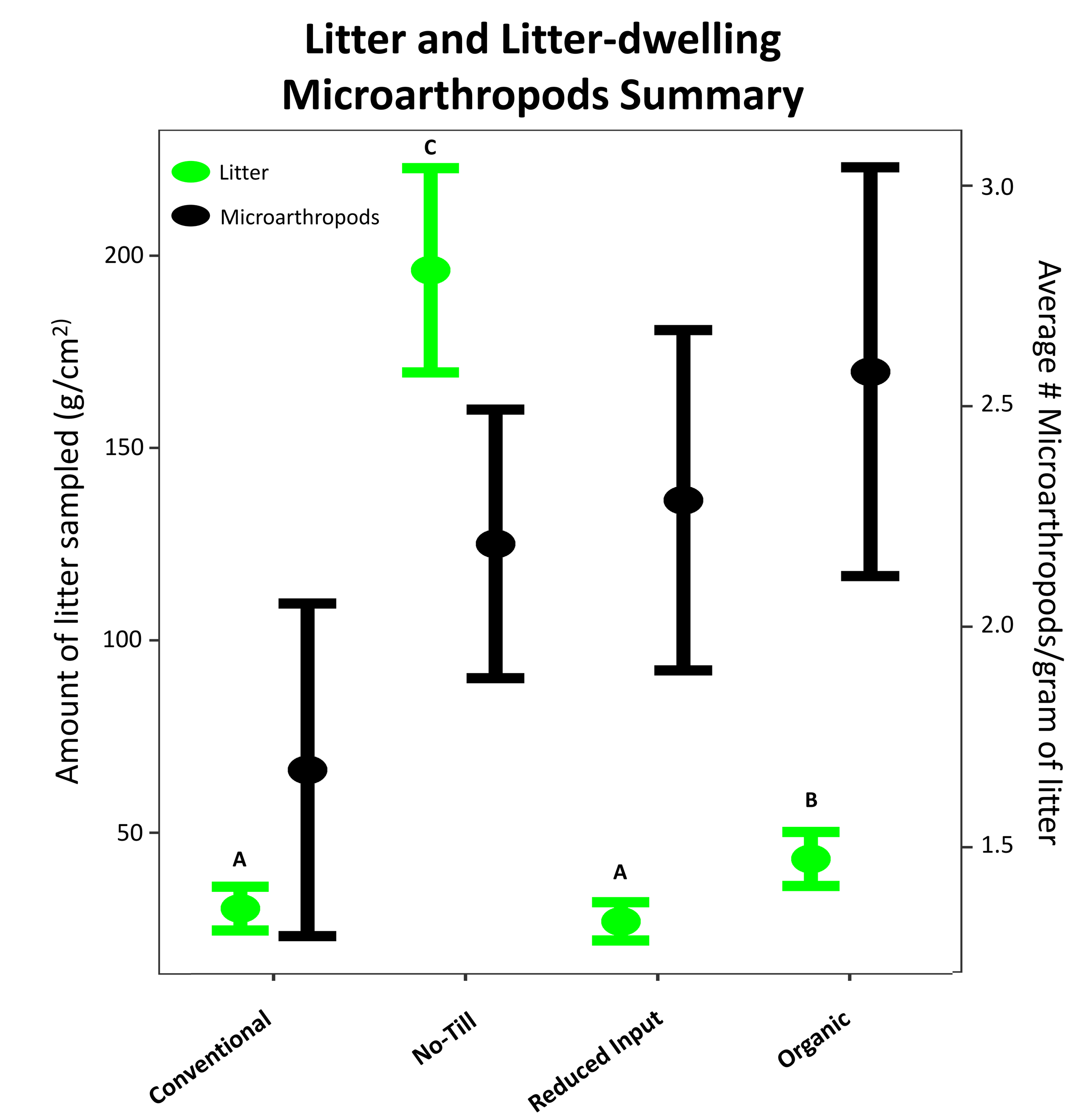

Fig 2. Comparison of the average amount of litter collected per litter quadrat sample and the number of overall microarthropods collected per gram of litter. Bars indicate standard error of the mean. Different letters across bars or columns indicate significant differences (p ≤ 0.05).

Discussion

- Overall microarthropod abundance in May 2019 was far greater in litter than in soil, perhaps in part due to the very wet spring. In soil, the Organic treatment had 2-fold higher abundance of microarthropods than any other treatment. While the No-till system had by far the greatest amount of litter, on a per gram of litter basis the Organic system had the highest microarthropod abundance followed by Reduced input and No-till systems.
- Interestingly, the pattern of microarthropod abundance in litter roughly tracks the pattern of previous measures of SOC in surface soils, which in 2001 was greatest in Organic followed by No-till and Reduced input and lowest in Conventional.
- Further study into the differences in microarthropod community structure and activity under a gradient of agricultural intensification is necessary to help uncover the relationship between microarthropod functioning and soil organic carbon accrual in differently managed agricultural systems

References

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