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CASE STUDY CS15

Use of catch crop in early potato field

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Objective

The objective for CS15 is to investigate how catch crops benefit soil biodiversity and biological soil fertility and related ecosystem functions.

State of the art

Early potato cultivation period in the boreal area is short and as it is often intensive utilizing deep ploughing, irrigation and mineral fertilization. Thus, the short and intensive cultivation cause high risk of nutrient and carbon leaching from soils into groundwaters causing eutrophication and carbon loss.

Problem to solve

Growing season for early potato cultivation is short (about 60 days). In addition, harvesting for early potato in the boreal region is conducted before flowering time. Thus, is expected that practices conducted in fields after the harvest would be important for soil community maintaining favorable soil conditions. Catch crops may add carbon to soil, contribute to good soil structure, and promote microbial and faunal function and restrict erosion of soil. Catch crops may benefit soil quality especially after the harvest, as they take up nutrients through the summer and autumn.

Proposed practices

Catch crops sown after the harvest in early potato fields are proposed to increase soil biological diversity, carbon storage and soil health.

Preliminary results

Soil physical and chemical characteristics in the treatment plots of the CS15 experiment have been determined from the first (2020) and second (2021) year of the experiment. The soil data is represented in the Tables 1-2. Soil characteristics after the first and the second experimental year between the treatment plots are very alike. We expect to see changes in some of these parameters after the third monitoring year.

Table 1. Mean values (SD in parenthesis) of soil physical characteristics from the replicate treatment plots (n=4). Abbreviations: BD: bulk density; Rfg: rock fragments and gravels; WH: water-holding capacity; SA: sand content; SI: silt content; CL: clay content; Agsd_b: aggregates size distribution >2000; Agsd_c: aggregates size distribution 250-2000; Agsd_d: aggregates size distribution 53-250; Agsd_e: aggregates size distribution <53.

Year	Treatment	BD (g cm^{-3})	Rfg (%)	WHC (%)	SA (%)	SI (%)	CL (%)	Agsd_b (%)	Agsd_c (%)	Agsd_d (%)	Agsd_e (%)
	control				65 (5)	19 (4)	11(3)	20 (7)	38 (4)	32 (7)	9 (1)
2020	phacelia				65 (4)	19 (3)	10 (2)	17 (4)	39 (4)	35 (4)	10 (4)
	rye/Westerword ryegrass				64 (3)	20 (3)	12 (2)	14 (4)	42 (5)	33 (2)	11 (3)
	control	0.40 (0.005)	45 (5)	29 (0.3)				74 (8)	19 (5)	5 (2)	3 (1)
2021	phacelia	0.40 (0.02)	43 (3)	28 (1)				65 (6)	26 (4)	6 (2)	3 (1)
	rye/Westerword ryegrass	0.41 (0.03)	47 (5)	29 (1)				71 (10)	20 (7)	6 (2)	3 (1)

Table 2. Mean values (SD in parenthesis) of the soil chemical characteristics from the replicate treatment plots (n=4). Abbreviations: TOC: total organic carbon as g kg-1; POC: particulate organic carbon as g kg-1; Ntot: total nitrogen as g kg-1; Pav: available phosphorus as mg kg-1; Kex: exchangeable potassium as cmol kg-1; . Caex: exchangeable calcium as cmol kg-1; Mgex: exchangeable magnesium as cmol kg-1; Naex: exchangeable natrium as cmol kg-1; NH4 and NO3 as mg kg-1.

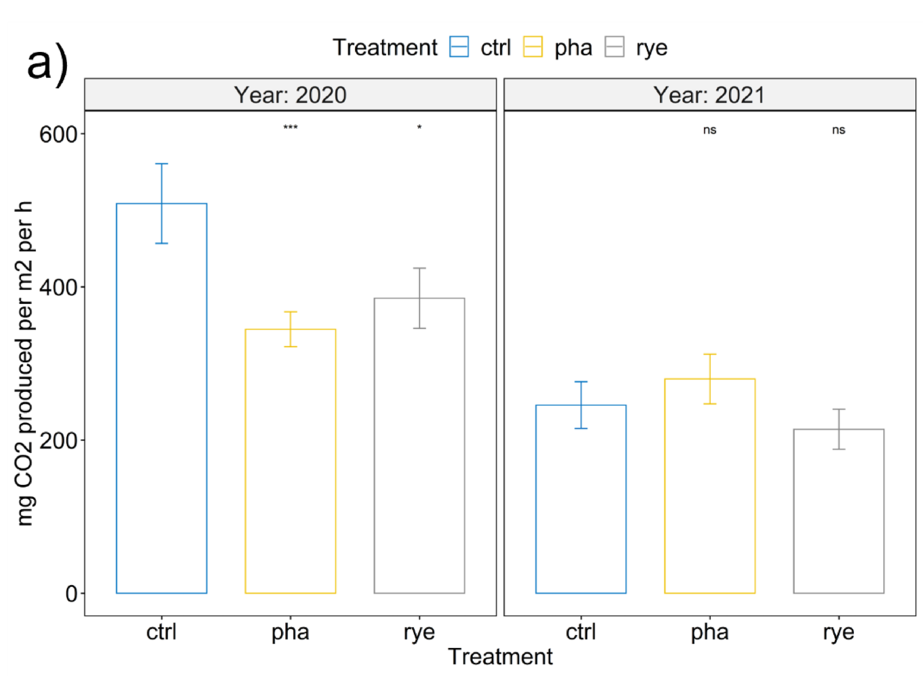
Year	Treatment	soil pH	TOC (%)	POC (%)	N_{tot}	P_{av}	K_{ex}	Ca_{ex}	Mg_{ex}	Na_{ex}	NH_4	NO_3
	control	6.4 (0.10)	20.7 (1.9)	11.9 (6.8)	1.7 (0.1)	95 (9)	0.5 (0.1)	6.2 (1.1)	0.6 (0.1)	0.08 (0.01)	2.1 (0.4)	29 (13)
2020	phacelia	6.4 (0.24)	20.7 (1.8)	8.5 (3.0)	1.7 (0.1)	96 (11)	0.5 (0.04)	6.0 (0.4)	0.6 (0.05)	0.09 (0.01)	2.4 (1.2)	15 (5)
	rye/Westerword ryegrass	6.5 (0.08)	20.7 (2.8)	11.4 (1.6)	1.7 (0.2)	92 (12)	0.4 (0.1)	6.1 (1.4)	0.6 (0.2)	0.07 (0.01)	2.9 (0.2)	18 (4)
	control	6.5 (0.16)										
2021	phacelia	6.3 (0.27)										
	rye/Westerword ryegrass	6.5 (0.11)										

In the first experimental year CO_2 fluxes were lower in plots with phacelia and those with rye/Westerwold ryegrass mixture (Figure 1a), whereas CH_4 turned from the sink to source in plots with Westerwold ryegrass/rye mixture (Figure 1c). N_2O fluxes did not differ between treatment plots (Figures 1b).

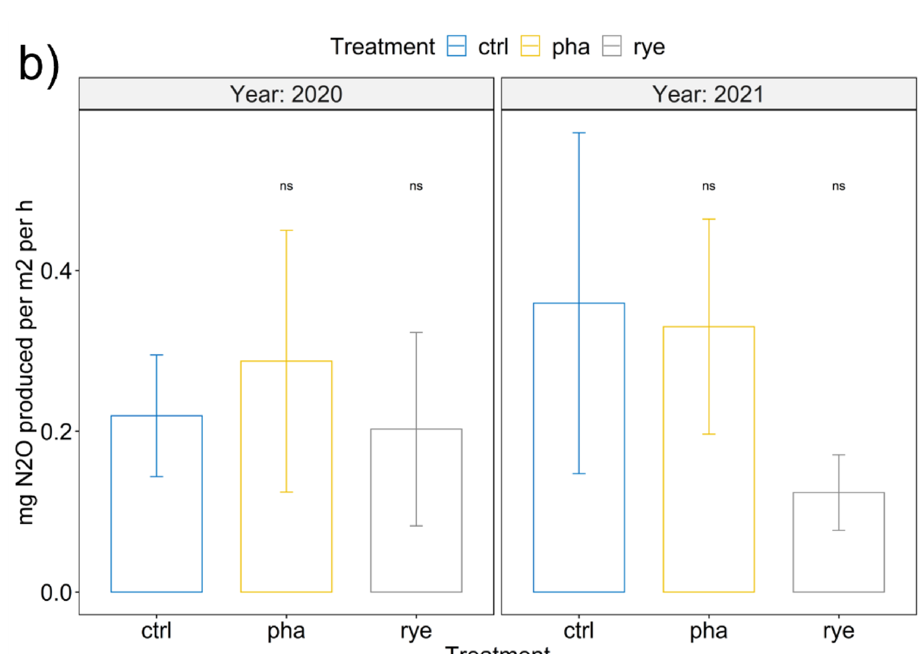
When the data from the third monitoring years will be available, only then we are able make the conclusions about the amendment effect on GHGs. The data will also be analyzed along with soil chemical and physical data with more sophisticated statistical models to verify their relationships with organic amendments and catch crops and fluxes.

However, exceptionally high CO_2 fluxes were measured in the beginning of the experiment soon after sowing the catch crops in June 2020 from the control plots compared to the plots with catch crops, which probably affects largely the overall result. Exceptionally high CH_4 fluxes were also obtained from the plots with Westerwold ryegrass/rye mixture in the beginning of the experiment in June and during the last measurement timepoint in the end of September.

a)



b)



c)

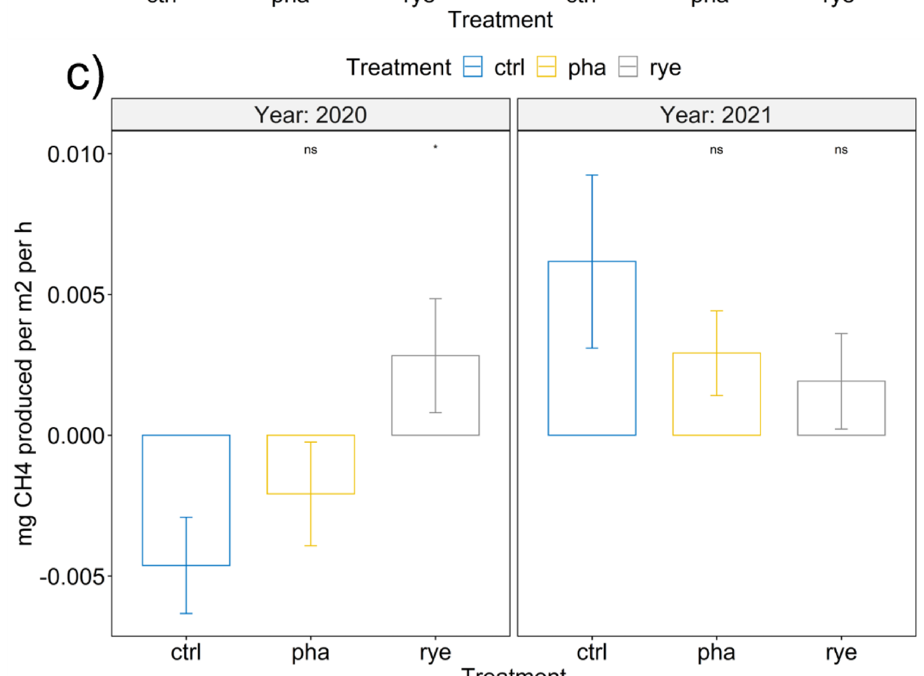


Figure 1. Mean a) CO_2, b) N_2O and c) CH_4 fluxes (with SE bars) in the control plots without catch crop (ctrl), plots with phacelia as catch crop (pha), and plots with mixture of rye and Westerwords ryegrass as catch crop (rye) in the first and the second sampling years 2020 and 2021.

Total number of nematodes (preliminary data from EV-ILVO) did not differ between treatments in the first (2020) or the second (2021) year of the experiment (Figure 2). However, there was a slight increasing trend towards higher nematode amounts in the plots with catch crops compared to control of plots.

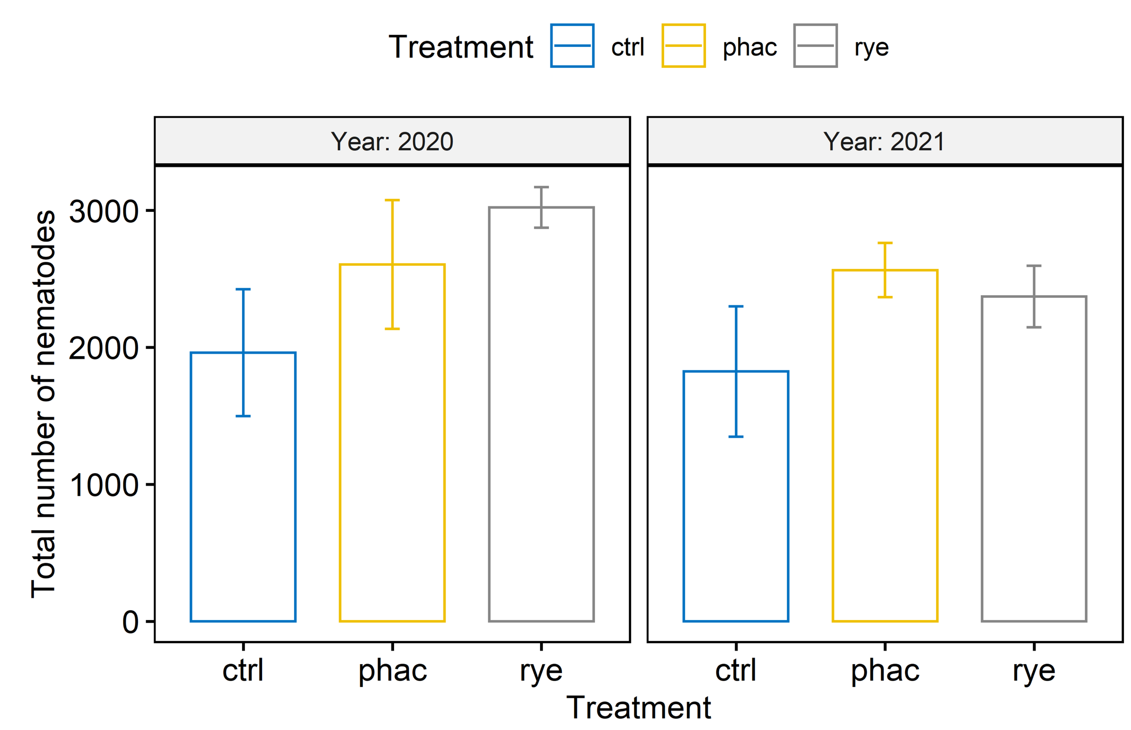


Figure 2. Mean total number of nematodes (with SE bars) in the control plots without catch crop (ctrl), plots with phacelia as catch crop (phac) and plots with rye and Westerwold ryegrass as catch crop (rye) in the first and the second sampling years 2020 and 2021.

Total abundance of earthworms did not differ between the treatments in the first (2020) or the second (2021) year of the experiment (Figure 3). Notably, the abundances in the field are very low and variable within treatment plots, especially in the plots with phacelia as a catch crop.

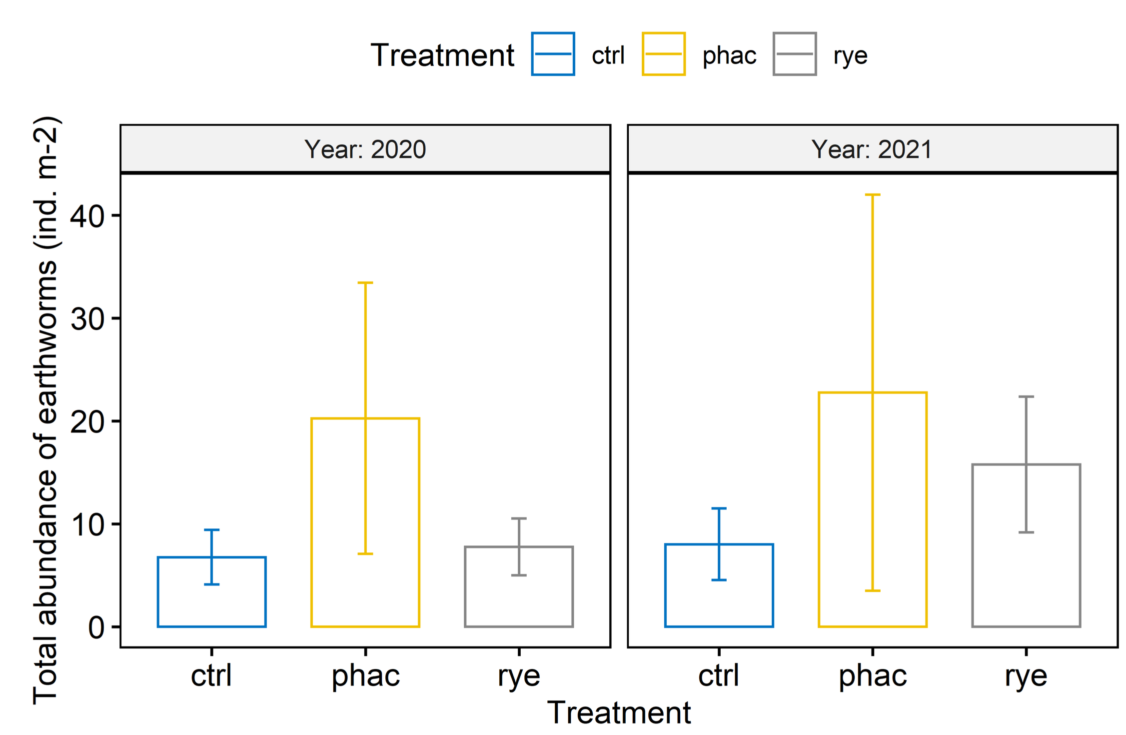


Figure 3. Mean total abundance of earthworms (with SE bars) in the control plots without catch crop (ctrl), plots with Phacelia as catch crop (phac) and plots with rye and Westerwold ryegrass as catch crop (rye) in the first and the second sampling years 2020 and 2021.