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THE EFFECT OF LONG-TERM CROP ROTATIONS ON SOIL PROPERTIES IN SPRING BARLEY CROPS

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Introduction

Intensive farming and short crop rotations have encountered problems of soil degradation. Finding solutions to these problems as well as new challenges requires returning to old farming practices, adapting them to current issues.

The aim of the research was to investigate the effect of long-term crop rotation combinations on soil properties in spring barley crops. Crop rotations with perennial grasses or manure fertilization have demonstrated a positive effect on soil properties. Improving the agrophysical properties also improves the biological and chemical soil properties. This tendency becomes apparent in the field experiment carried out for more than fifty years in the same place.

Methodology

A stationary field experiment was set up in 1965 under the initiative of Prof. Dr. A. Stancevičius at Vytautas Magnus University Experimental Station (54° 53′N + 23° 50′ E). The field experiment was carried out in 2018 in spring barley crops in 5 different crop rotations: intensive, field with row crops, cereal, for green manure and Norfolk as well as continuous bare fallow. Plant protection measures were applied as needed, the same tillage systems were applied for all crop rotations.

Results

Table 1. Soil shear resistance in spring barley in 2018

	Crop rotations						
kPa	FAL	INT	CE	FWR	NOR	FOD	FGM
10 cm	69.6 b	67.5 b	52.6 ac	52.1 c	69.9 b	66.8 b	59.6 ab
25 cm	67.9 c	67.5 bc	56.5 ab	55.7 a	80.7 d	58.0 abc	59.4 abc

Table 2. Soil structure and structural stability in spring barley in 2018

	Crop rotations						
%	FAL	INT	CE	FWR	NOR	FOD	FGM
Micro	7.8 a	7.2 a	6.0 a	5.4 a	6.9 a	5.0 a	7.4 a
Macro	62.1 a	50.8 a	45.6 a	47.6 a	52.7 a	50.1 a	50.3 a
Mega	92.2 a	92.8 a	94.0 a	94.6 a	93.1 a	95.0 a	92.6 a
Stability	12.7 a	43.7 bcd	31.9 bc	49.6 d	46.1 cd	58.0 d	28.5 ab

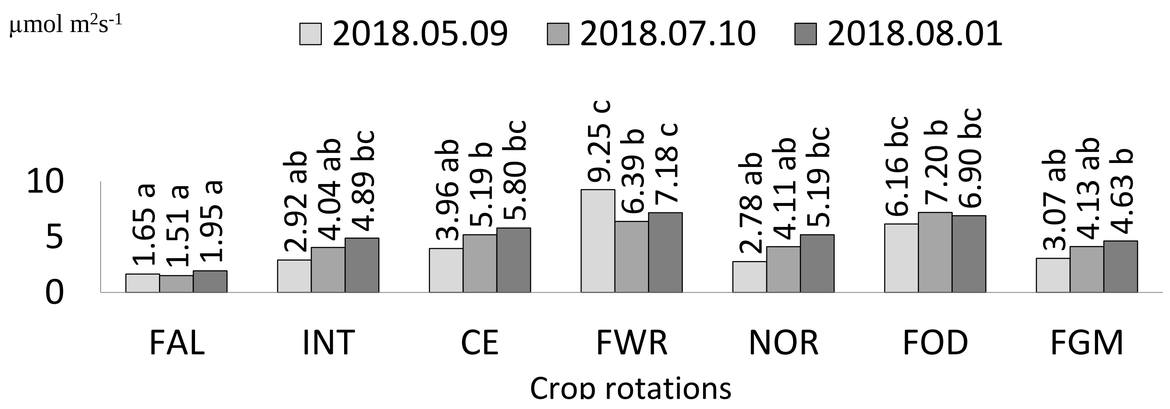

Figure 1. Soil CO_2 emissions in spring barley crops

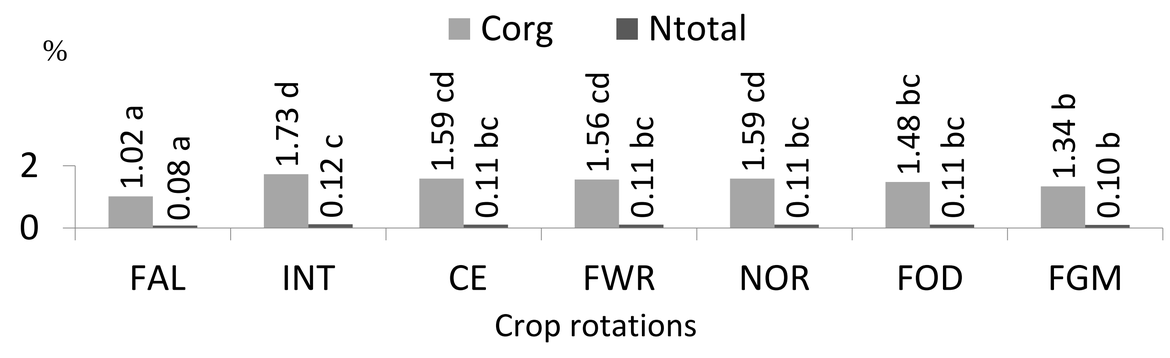

Figure 2. Soil C_{org} and N_{total} in spring barley crops at the depth of 0-20 cm

Notes. *[a-d] Means followed by the same letter for the same measurement did not differ significantly (P<0.05). FAL – continuous bare fallow, CE – cereal, FWR – field with row crops, NOR – Norfolk, FOD – fodder, FGM – for green manure (after winter rape incorporation).*

Conclusions

- In spring barley crop, soil shear resistance at the depths of 10 cm and 25 cm was found to be significantly higher (P <0.05) in the Norfolk crop rotation and continuous bare fallow compared to the soil of field with row crops.
- Significantly lower soil structure stability (P <0.05) was found in the fields of continuous bare fallow, in which no plant residues were inserted compared to other combinations.
- The lowest soil CO_2 emissions were found in continuous bare fallow. Compared to bare fallow, all cereals studied showed increased soil CO_2 emissions. Throughout the vegetation period of spring barley, the highest soil CO_2 emissions were found in the field with row crops and fodder crop rotations.
- The highest organic carbon content was found in spring barley crops, in intensive crop rotation with the pre-crop being maize, to which winter rye was applied as green fertilizer before sowing. The Total Nitrogen and the organic carbon content was the highest in the same crop rotation, namely: in spring barley crops – in the intensive crop rotation.