The influence of intensive and sustainable farming on the modification of mineral nitrogen (N_{min}) and soil organic carbon (SOC) in Lithuanian histosoils

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Introduction

In Lithuania, about 9% of all cultivated fields consist of histosoil, which is a very valuable soil due to the high amount of soil organic matter (>20%) (Volungevičius et al., 2015). In histosoils, in comparison with mineral soils, there are more intense biological, chemical, physical processes that promote the mineralization of nitrogen and carbon. Due to difficult treatment of histosoils, they were most often used to grow natural meadows, so this slowed down soil organic matter (SOM) mineralization (Tiessen, 1983, Turner et al., 2017). However, with the advancement of agricultural technology, farmers are increasingly determined to use histosoils in intensive farming, which encourages soil mineralization (Arbačiauskas et al., 2014, Kolka et al., 2016). Therefore, the aim of the work was to evaluate the influence of intensive and sustainable farming on the change of N_{min} in Lithuanian histosoils in 0 - 30 cm depth in different periods of time.

Materials and methods

To achieve the goal, 18 sites were selected in different places in Lithuania (9 locations (figure 1)). In each location, three platforms with a maximum of 10 x 10 meters were selected according to the exact GPS coordinates. Three samples (three replicates) were taken from each site. The study attempted to compare the impact of sustainable and intensive farming to SOM. There were two choices for this:

(a) intensive farming was used in the soil sample - fields were ploughed every year and crops and other plants were cultivated; (b) sustainable farming was used in the soil sample - grass, which was cut more than several times during the season, was planted.

Soil samples were collected in the autumn from 2017 to 2018.

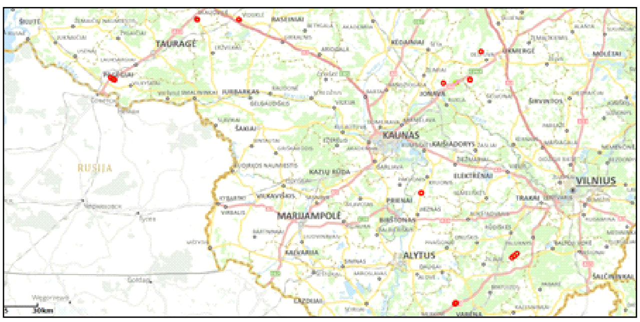

Figure 1: Locations of soil sampling for mineral nitrogen (N_{min}) and soil organic carbon (SOC) tests in Lithuania

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Results and discussion

The research shows that the most intensive soil nitrogen and carbon transformation processes take place in intensive farming agriculture (Table 1).

Table 1: The soil organic carbon (SOC) and mineral nitrogen (N_{min}) in different histosoils.

Treatment	2017 autumn		2018 autumn	
	SOC g kg^{-1}	N_{min} mg kg^{-1}	SOC g kg^{-1}	N_{min} mg kg^{-1}
Intensive farming	241 ±8.31	88.9 ±12.92	238 ±10.72	103.9 ±9.44
Sustainable farming	357 ±17.59	54.9 ±11.62	358 ±16.38	62.6 ±8.33
LSD_{005}	23.42	5.68	41.16	7.99

The research showed that the amount of SOC in organic histosoils changes slowly. During one year it changed from 241 g kg^{-1} to 238 g kg^{-1} in intensive farming and from 357 g kg^{-1} to 358 g kg^{-1} in sustainable farming. However, the research showed that long-term (more than 10 years) of intensive farming using histosoils resulted in 34% decrease in SOC compared to sustainable farming.

The N_{min} studies on organic soils showed that N_{min} changed from 10 to 12% a year, largely due to the different climatic conditions that led to the activity of microorganisms and the leaching of nitrates.

However, the studies showed that N_{min} concentration was 38 - 40% lower in sustainable farming compared with intensive farming in all years of the research.

Conclusions

The differently used histosoil has unequal content of SOC. Sustainable farming agricultural histosoils had higher amount of SOC compared with intensive farming histosoils. Intensive farming influenced the amount of N_{min} that was higher compared to sustainable farming, which is not good because high amount of N_{min} causes surface water and groundwater contamination.

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