VYTAUTAS MAGNUS UNIVERSITY AGRICULTURE ACADEMY

10th International Scientific Conference RURAL DEVELOPMENT 2021 Challenges for Sustainable Bioeconomy and Climate Change

Impact of fish processing by-product amendment on soil properties

Rimantas Vaisvalavičius, Rūta Dromantienė, Irena Pranckietienė, Jūratė Aleinikovienė
Vytautas Magnus University Agriculture Academy

Introduction

Sustainable management of food waste is one of the most important issues facing the world today (Garcia-Garcia et al., 2017). The use of organic wastes in agriculture provides the opportunity to simultaneously increase soil productivity and contribute to the sustainable management of organic waste (Eden et al., 2017).

The fisheries wastes contain nitrogen, phosphorus, potassium, calcium, magnesium, sulfur and microelements making it an excellent broad-based organic fertilizer (Illera-Vives et al., 2015; Radziemska et al., 2019). For that, fish waste may be processed for food, feed, technical and pharmaceutical purposes, may be also used for energy production or fertilizers (Ghaly et al., 2013; Ahuja et al., 2020).

Aim of study

The aim of this study was to analyze and identify changes to agrochemical soil characteristics and soil microbiota biomass properties 12 months after the fish bones powder application.

Figure 1. Potting experiment: 5 l in volume vegetative pots with the soil and fish bones mixture

Methodology

The amount of soil necessary for the experiment of amendment with fish processing by-products was collected from the plowing soil layer (Ap horizon) of the Endocalcaric Endogleyic Luvisol at the Pomological Garden of VMU Agriculture Academy. Fish bones in a powder form (FBP) were mixed with the soil and placed into vegetative pots (Figure 1) up to the soil thickness reached of 25 cm. The effect of increasing FBP doses (respectively, 2.5; 4.5; 6.5 t ha^{-1}) was compared to the control treatment (without any fertilization). Vegetative pots have been transported in to the open environment in order to create outdoor conditions as natural for arable soil layer in selected locality. Soil samples were collected from the substrates in the vegetative pots 360 days after the application of fish processing by-products. Substrates from each vegetative pot were mixed and homogenized in a separate vessel. Then about 150 g soil was collected from each pot for the analysis of soil chemical and microbiological properties. The potting experiment has been implemented in 6 replicates.

Results

Table 1. Soil chemical properties in fish bones powder (FBP) treatment in potting experiment

Treatment t ha^{-1}	pH	C_{org}	N_{Total}	N_{Min}	P_2O_5	K_2O	Ca	Mg	S
		%		mg kg^{-1}					
Control	6.8	8.55	0.647	46.55	101	50	8176	668	3.1
2.5	6.8	9.16*	0.635	46.19	596*	56	9100*	706	2.9
4.5	6.8	10.12*	0.649	49.98	419*	59*	10086*	742	2.6
6.5	6.8	10.35*	0.712*	65.28*	577*	60*	9424*	706	2.9

Note: * – significant at $p \leq 0.05$

Table 2. Soil microbiota mean total abundance and soil microbiota biomass C and N under the FBP treatment in potting experiment

Treatment	Abundance of microbiota ± SD	Microbiota biomass ± SD	
		C	N
t ha^{-1}	thousand CFU g^{-1} (DM)	µg C g^{-1}	µg N g^{-1}
Control	1031.1 ± 33.3	119.7 ± 5.8	13.3 ± 0.6
2.5	2395.0 ± 258.2	187.2 ± 7.1	26.7 ± 1.0
4.5	5938.0 ± 397.8	273.5 ± 12.4	45.6 ± 2.1
6.5	12169.5 ± 25.3	305.5 ± 9.2	50.9 ± 1.5

Note: SD – standard deviation of the mean

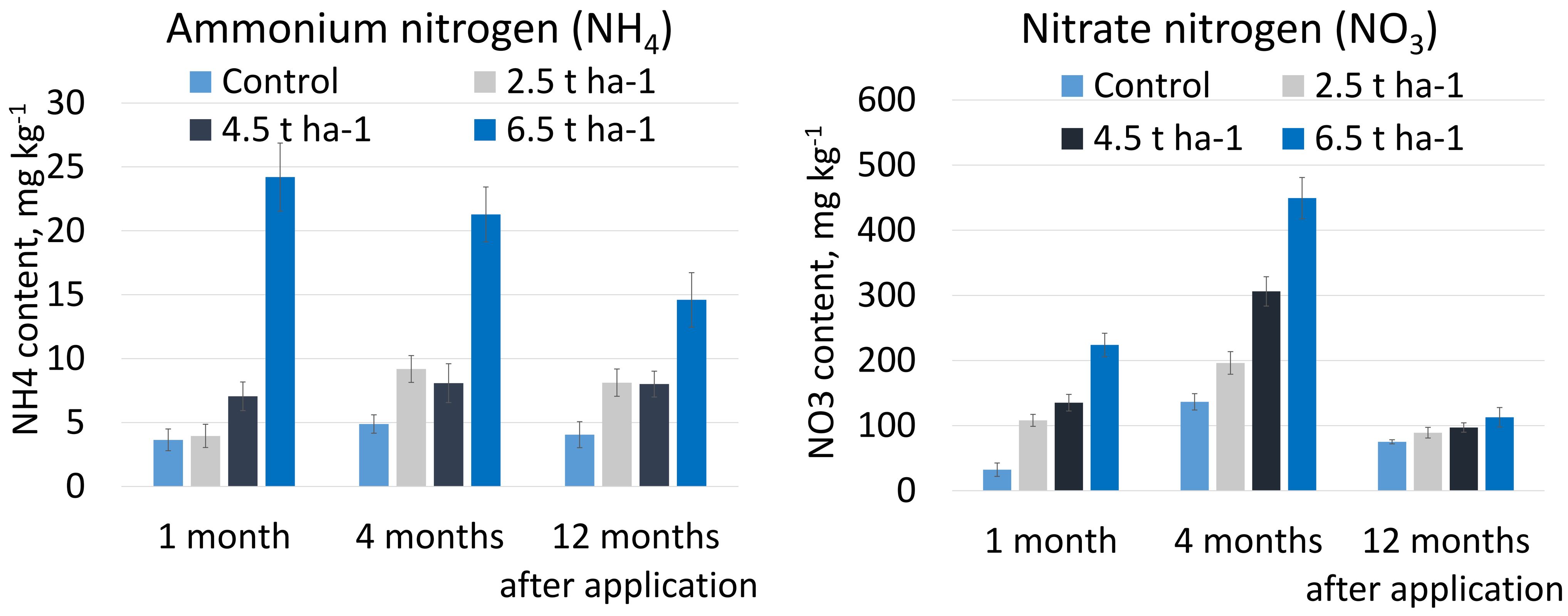

Figure 2. Impact of the FBP treatment on nitrogen content in soil in potting experiment

Main conclusions. Studies have shown that FBP can improve the agrochemical and microbiological soil properties. The treatment used significantly increases the amount of C_{org}, available P_2O_5 and K_2O contents as well calcium content in the soil. Only rate of 6.5 t ha^{-1} FBP significantly increases the amounts of total and mineral nitrogen in the soil. The treatment used did not have a decisive effect on the Mg and S content of the soil. FBP application has significantly influenced the increase in microbiota abundance and soil microbiota biomass C and N.

The European Community Seventh Framework Programme – FP7/2007-2013 project - APROPOS