RESEARCH OF MIGRATION OF ECOLOGICAL FERTILIZERS (BIOFER AND ACTIVIT) IN SOIL

Laima Česonienė, Kristina Lingytė, Daiva Šileikienė

Aleksandras Stulginskis University, Lithuania

Abstract

Fertilizing intensively plants with fertilizers a part of unspent nutritional elements of plants and not being mobilized into steady compounds migrates into deeper layers, consequently causing a danger to underground waters' pollution. The aim of the work is to define a migration of alimentary materials ((NH_4^+), (NO_2), (NO_3), (PO_4^{3})) in soil after using ecological fertilizers (Biofer and Activit). The base of the research is 35 samples in model systems of unmoved soil, top-dressed with ecological fertilizers (Biofer and Activit). Results of the research have shown that in the average heavy clayey soil the concentration of nitrogen compounds and phosphate in the soil depends on the amount of used ecological fertilizers (Biofer and Activit). After using Activit and Biofer fertilizers in 1 soil's layer (10 cm) it has been set that the highest concentration of nitrites and nitrates is in 30 days after the soil was fertilized. The highest concentration of ammonium ions and phosphates has been set in 1 soil's layer (10 cm) in 10 days after the soil was fertilized with fertilizers (Biofer and Activit).

Keywords: *nitrogen, soil, migration, monolit soil system*

INTRODUCTION

As the result of irrational use of fertilizers (organic and mineral) and other chemical agents in agriculture a number of components is leached from black-soil and pollutes the environment. Excessive nitrogen and phosphorus content predetermines quick silt growing, and the silt takes much oxygen from water and leads to it lack, so in the majority of land places stable abiotic areas formed (Adomaitis et al., 2010).

Not only excessive mineral fertilizing can be hazardous to the environment. Biogenic components on both mineral and organic basis, entering the soil, become the pollutants, if they are not absorbed and enter surface and ground waters and pollute them (Mcgechan, Lewis, 2002).

Phosphorus pollution predetermines low solubility of this component and its property to accumulate in black soil (McGechan, Lewis, 2002). Differently from other biogenic components (N, S, C) phosphorus does not obtain gas forms, so its transportation mainly occurs only due to leaching or removal of fine powder fractions, and the pollution itself depends on phosphorus content and its forms, entering black-soil (Golubev, 1999). While fertilizing even with organic fertilizers, the reserve of mineral phosphorus compounds in black soil increases, so phosphorus migration under the soil increases (Tripolskaja, 2005). Due to increasing phosphorus impact on water ecosystems it is recommended to regulate fertilizing, considering the intensity of biogenic components and their content in black-soil (Djodjic et al., 2004).

Though nitrogen is one of the most spread in nature and the main plant feed component, its excess is hazardous to nature. The most hazardous to nature nitrogen form is nitrites (NO3-), which, differently from ammonia (NH4+), are not absorbed by black-soil and are easily taken by plants, so they migrate in biosphere. About 90-98% of nitrogen from black-soil is leached in the form of nitrates. A share of nitrates becomes hazardous nitrates (NO2-) (Adomaitis et al., 2004). As the result of non-efficient use of nitrogen fertilizers nitrites can be leached to groundwater, pollute water bodies and rivers (Jensen, Hauggaard-Nielsen, 2003; Dobermann, Cassman, 2004).

This also urgent for our country, because more and more farmers, in order to get rich harvest, use great rate of nitrogen fertilizers, which do not always meet plant demands and the component reserve in black-soil, so there is hazard of environment pollution with the fertilizers (Mažvila et al., 2006).

Therefore, in order to use organic fertilizers rationally and prevent environment pollution, it is important to balance nitrogen and phosphorus. (Švedas and Antanaitis, 1999).

The paper objective is to establish plant food ((NH_4^+), (NO_2^-), (NO_3^-), (PO_4^{3-})) migration in black-soil after the use of ecological fertilizers (Biofer and Activit).

RESEARCH OBJECT AND METHOD

The research is carried out in silty light loam Endohypogleyic-Eutric Planosol PLb–g4 (Endohypogleyic-Eutric Plannosol- Ple – gln-w).

The research basis – 35 samples in model unmoving soil systems. Samples were taken to metal cylinders, which height makes 50 cm, and diameter – 4 cm. Bottom cylinder end was tightly closed with a film, and the upper end was open. All cylinders were stored in the laboratory under equal temperature and moisture conditions. According to the data of Kaunas Meteorological Station, average precipitation amount makes 3 mm of precipitation per day, so black-soil is watered with 3 mm of distilled water daily.

In order to protect the environment against negative impact, the EU countries established the loads for agricultural land. Maximum permissible load cannot exceed 170 kg N ha-1 per year (Official Gazette, 2010, No. 85-4492). Following the environmental safety requirements, the amount of Biofer fertilizers was calculated during the research according to circle area (0.04 m^2) and nitrogen content per 100 kg of fertilizers. Biofer (B) fertilizers contain 10 % of nitrogen.

The amount of Activit fertilizers was calculated during the research according to circle area (0.04 m^2) and nitrogen content per 100 kg of fertilizers. Activit (Ac) fertilizers contain 4.24 % of nitrogen.

Black-soil samples with metal cylinders, and used fertilizers (total 35 cylinders):

5 cylinders (the lowest norm) – Biofer B60 (2,4g);

5 cylinders (the average norm) – Biofer B120 (4,8g);

5 cylinders (excess norm) – Biofer B180 (7,2g);

5 cylinders (the lowest norm) – Activit Ac1000 (94,3g);

5 cylinders (the average norm) – Activit Ac1250 (117,9g);

5 cylinders (excess norm) – Activit Ac1550 (146,2g);

5 cylinders – cintrol

The samples in the set time periods were taken in 10, 30, 60, 100 days. The cylinder content was divided into five layers, i.e. by 10 cm. The following parameters are established in each layer: ammonia ion (NH_4^+), nitrite (NO_2^-), nitrate (NO_3^-), phosphate contents (PO_4^{3-}). The samples were tested in the Environmental Research Laboratory of Aleksandras Stulginskis University according to the approved methods.

RESULTS

Figure 1 demonstrates nitrite contents in different model soil layers in 10 and 30 days after insertion of Activit and Biofer fertilizers**.**

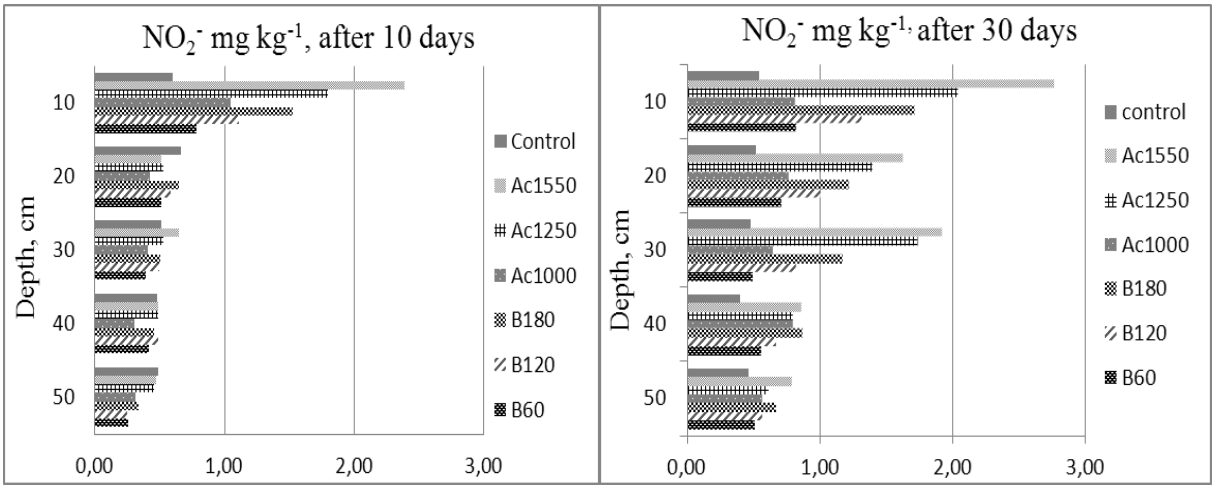


Fig. 1. Concentration of nitrites in the soil in 10 and 30 days after the soil was fertilized with Biofer and Activit

The tests demonstrated that the much amount of Activit and Biofer fertilizers is used, the much in nitrite content in black-soil. In 10 days maximum nitrite content is in the first soil layer (10 cm). In 30 days after the use of fertilizers nitrite content increased in all soil layers, and was especially high in the first model soil layer, after the use of maximum rate of Activit fertilizer (1550) insertion (2.77 mg kg-1). In 60 and 100 days nitrite content decreased in all soil layers.

Similarly nitrites migrate in soil. Figure 2 demonstrates nitrate contents in different model soil layers in 10 and 30 days after insertion of Activit and Biofer fertilizers.

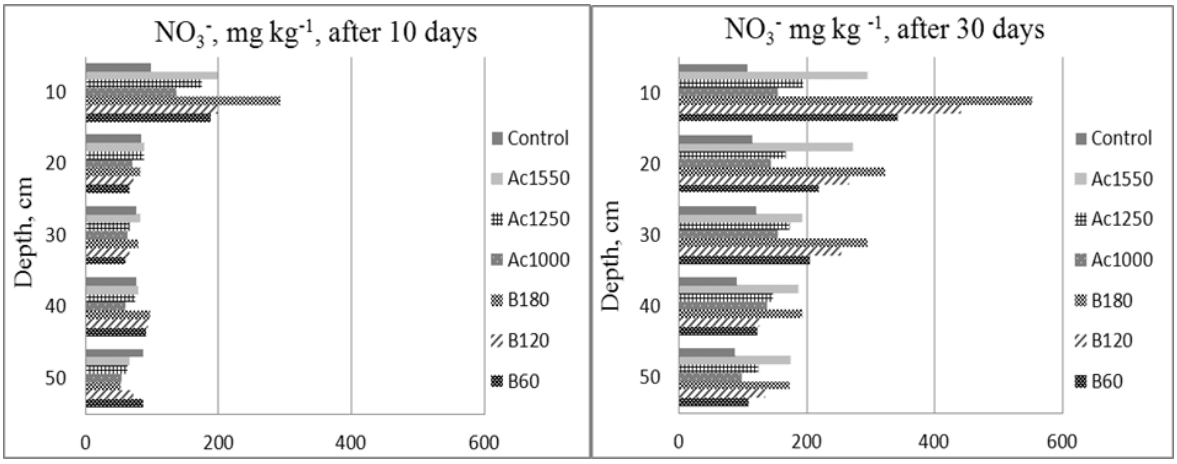


Fig. 2. Concentration of nitrates in the soil in 10 and 30 days after the soil was fertilized with Biofer and Activit

In 10 days after the test date maximum nitrate content is in the first soil layer (10 cm.) after the use of all rates of Activit and Biofer fertilizers. In 30 days nitrate content increased in all soil layers, and it was especially high in the first model soil layer after the use of all rate of Biofer fertilizers (B180 - 552

mg kg-1, B120 - 442 mg kg-1, B60 - 319 mg kg-1) and after the use of maximum rate (293 mg kg-1) of Activit fertilizers (1550). In 60 and 100 days nitrate content decreased in all soil layers.

Figure 3 demonstrates ammonia ion contents in different model soil layers in 10 and 30 days after insertion of Activit and Biofer fertilizers.

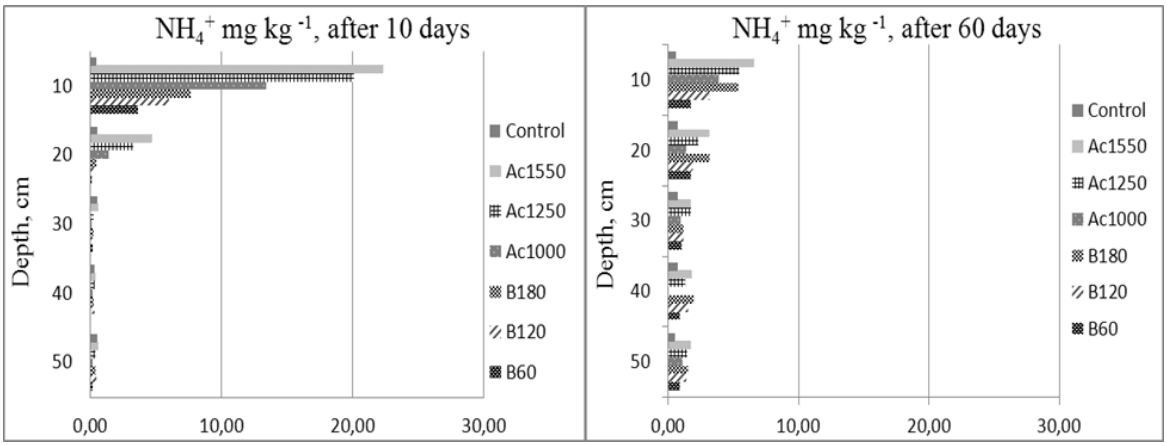


Fig. 3. Concentration of ammonium ions in the model systems of unmoved soil in 10 and 60 days after the soil was fertilized with Biofer and Activit

In 10 days after the use of Activit and Biofer fertilizers maximum ammonia ion content was in the first soil layer (10 cm.), it was especially high after the use of maximum rate (22.08 mg kg-1) of Activit fertilizers (1550). Ammonia ion content in the second layer increased only after the insertion of maximum (Ac1550) and medium (1250) rate of Activit fertilizers, comparing with the check variant. Ammonia ion content in other soli layers is similar. In 30 days after the use of fertilizers maximum ammonia ion content was in the first layer, in other soil layers ammonia ion contents are similar to the check models. In 60 days after the use of Activit and Biofer fertilizers ammonia ion content reduced in the first layer, but increased in the second-fifth soil layers. In 100 days ammonia ion content decreased in all layers, however it remains maximum in the first soil layer (10 cm.).

Figure 4 demonstrates phosphate contents in different model soil layers in 10 and 30 days after insertion of Activit and Biofer fertilizers

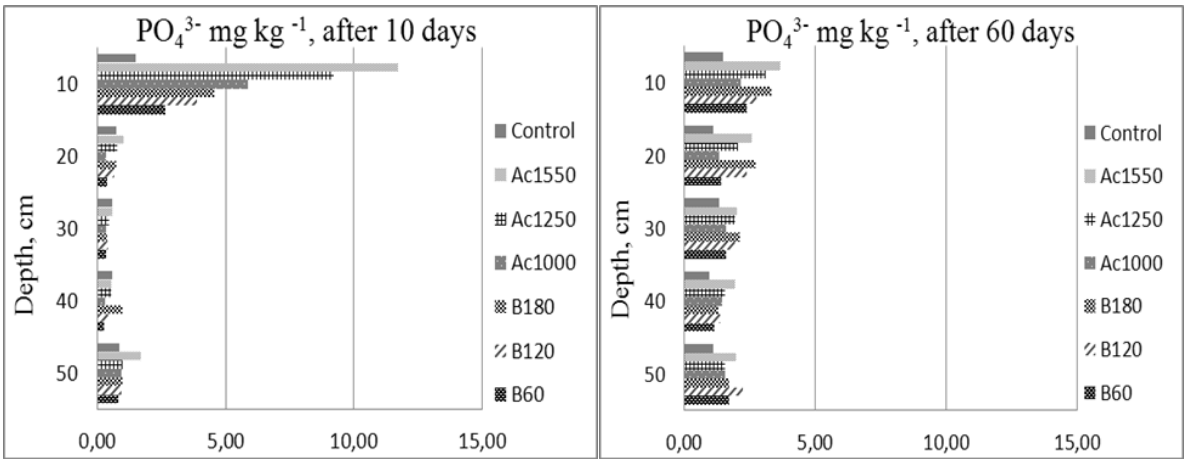


Fig. 4. Concentration of phosphates in the soil in 10 and 60 days after the soil was fertilized with Biofer and Activit

The tests demonstrated that phosphate content in black-soil depends on the amount of used ecological (Biofer and Activit) fertilizers. In 10 days after the use of Activit and Biofer fertilizers maximum phosphate content was in the first soil layer (10 cm.), it was especially high after the use of all rates (Ac1550 – 11,71 mg kg-1, Ac1250 – 9,20 mg kg-1, Ac1000 – 5,84 mg kg-1) of Activit fertilizers. In other soil layers phosphate contents were regular, similarly to check models (fertilizers were not used). In 60 days after the use of Activit and Biofer fertilizers maximum phosphate content was in the first soil layer (10 cm.), is significantly increased in other soil layers (20-50 cm.). In 100 days phosphate content decreased in all layers.

CONCLUSIONS

1. The tests demonstrated that nitrogen compound and phosphate contents in black-soil depend on the amount of used ecological (Biofer and Activit) fertilizers.
2. After the use of Activit and Biofer fertilizers maximum nitrite content in the first soil layer (10 cm.) was established in 30 days after insertion of the fertilizers (Ac1550 – 2.77 mg kg^{-1}).
3. Maximum nitrate content after the use of fertilizers (Activit and Biofer) was established in 30 days in the first soil layer (10 cm.) (B180 - 552 mg kg-1).
4. After the use of Activit and Biofer fertilizers maximum ammonia ion content in the first soil layer (10 cm.) was established in 10 days after insertion of the fertilizers (Ac1550 - 22,08 mg kg^{-1}), maximum phosphate content after insertion of the fertilizers was established in 10 days in the first soil layer (Ac1550 – 11,71 mg kg^{-1}).

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