ISSN 1644-0625
ISSN 2300-8504 (online)
www.agricultura.acta.utp.edu.pl

Acta Sci. Pol. Agricultura, 14(2) 2015, 15-27

THE EFFECT OF LONG-TERM IRRIGATION OF MEADOWS ON THE STATE OF ORGANIC MATTER

Andrzej Dziamski, Magdalena Banach-Szott, Bożena Dębska
University of Science and Technology

Abstract. The complex of Czersk Meadows, irrigated since the middle of the 19th century with the strip-flood system, is unique on the European scale. The aim of this study was to estimate the content of organic carbon, total nitrogen and dissolved fraction of organic matter in conditions of long-lasting irrigation of grasslands. The studied areas included Czersk Meadows, irrigated for more than 150 years, and the areas that were not irrigated for more than 25 years (Green Meadows). The study area is characterized by rusty soils with features of podsolization (RWbi – *Albic Brunic Arenosols* (*Distric*)). Soil samples were collected from surface and subsurface horizons: A, AE, Bsv. There were determined as follows: the total content of organic carbon (TOC), total nitrogen (Nt) as well as dissolved organic carbon (DOC) and dissolved nitrogen (DNt). Higher accumulation of organic carbon and total nitrogen was found in the humus horizon of soils of systematically irrigated meadows as compared with the soils of meadows that were stopped to be irrigated. The contents of TOC and Nt in soil samples collected on Czersk Meadows increased along with the distance from irrigation ditches. Soils of irrigated meadows were characterized by a wider TOC/Nt ratio than the soils of not irrigated meadows. Constant irrigation of meadows also resulted in a high proportion of DOC and DNt in the humus horizon (A) of soils.

Key words: dissolved nitrogen, dissolved organic carbon, irrigation with the strip-flood system, rusty soils, total organic carbon, total nitrogen

INTRODUCTION

One of the basic component of soil, apart from mineral elements, is organic matter. It is heterogeneous in respect of chemical composition and it undergoes constant changes, among which the following directions can be distinguished: mineralization (decomposition to simple compounds) and humification (processes leading to formation

Corresponding author: dr inż. Andrzej Dziamski, Department of Botany and Ecology of University of Science and Technology in Bydgoszcz, S. Kaliskiego 7, 85-796 Bydgoszcz, e-mail: adziamski@utp.edu.pl

of soil humus.) The optimal situation in the given soil and climate conditions is the state of balance between the inflow of organic substance into soil and its mineralization. Decomposition of plant material has the most favourable course at the C:N ratio staying within the range 20-30:1 [Fotyma *et al*. 1987, Takeda 1998, Gonet 2007]. The degree of organic matter mineralization in soil is strictly dependent on the degree of plant supply in mineral nitrogen [Mazur 1991]. The higher deficit of nitrogen available for plants in the soil, the larger part of organic matter reserves undergoes the process of mineralization. The content and properties of organic matter are determined not only by physicochemical properties of the mother rock, the course of soil formation process and climatic conditions, but also vegetation and the way of soil utilization [Gonet 2007]. Organic matter determines the chemical, physical and biological properties of soils, including their quality, and first of all their fertility and productivity [Doran and Parkin 1994, Robinson *et al*. 1994, Gonet 2007]. It constitutes an essential part of carbon reserves of lithosphere, and the humic substances present in it are included into the global circulation.

The fraction of organic matter which water-soluble (dissolved organic matter – DOM), which is the most mobile in soil, plays an important role from the ecological point of view. In meadow soils, due to the high content of organic matter and biological activity, there are conditions favouring formation of this humus fraction. However, mobile DOM compounds can be leached deep into the soil profile and to ground waters [Zaujec 2001, Zsolnay 2001, Weil and Magdoff 2004]. According to Zsolnay [2001], reduction in the content of dissolved organic matter in meadow soils may favour carbon sequestration, and an increase in its leaching and losses. Irrigated meadows, by contrast with not irrigated, are characterized by a smaller oxygen access in the surface genetic horizons, which is connected with a higher level of ground waters and smaller losses of carbon, both in the form of CO_2 and the mobile fraction – DOM [Czaplak and Dembek 2000].

From the data of the United Nations Environmental Programme – UNEP - it follows that the soil layer to the depth of 1 meter is a store of about 2.2 mld tons of carbon, that is the amount three times more than the current level of CO_2 in the Earth atmosphere. During the last twenty five years, about 24% of the Earth's surface has already lost the natural fertility as a result of its unsustainable use (deforestation, urbanization processes, intensification of crops and irrational practices in agriculture and forestry) [UNEP Year Book 2012].

It is worth noting that soils of permanent grassland are an important reservoir of organic carbon, and its reserves are similar or higher than carbon reserves in forest soils [Gonet 2007]. Due to their specific biodiversity, meadow ecosystems are one of the most important ways of agricultural land use, preventing organic carbon losses in soils. Carbon exchange in the form of CO_2 and Corg which occurs in meadow ecosystems plays a crucial role not only on the scale of the region but also on the global scale. Based on the studies with carbon isotope 14C it was found that the mean time of about 50% of organic carbon undergoing sequestration in the surface layer of meadow soils is estimated at 1000-2000 years [Sapek 2009]. Therefore the dynamics of carbon exchange between the atmosphere and water and land ecosystems, both present and predicted, gains a particular importance in connection with the observed climate changes.

Increasing degradation of soils, including losses of organic C being, among other things, the result of changes in soil utilization and intensification of agricultural

production, needs taking action – preceded by scientific research – aiming at soil protection. Meadow ecosystems, thanks to specific features favouring organic carbon sequestration in soil, perform an essential role in the circulation of this element in nature.

The aim of this study was to estimate the effect of long-term irrigation of permanent grasslands on the state of soil organic matter.

MATERIAL AND METHODS

Soil samples

Samples of mineral soils for the study were collected from the permanent grasslands of the unique „Complex of Czersk Meadows", irrigated for about 150 years with the strip-flood system. The soils were formed from fluvioglacial sands and they represent Albic Brunic Arenosol (Distric) – WRB 2006). The Complex of Czersk Meadows is the historical name of permanent grassland in the area of the Tuchola Forest with the total area of about 2000 hectares [Sabiniarz 2006]. Developed areas of organic and mineral soils were named districts – treatments. Currently the studied area includes the areas that have been irrigated continuously until the present day and those where this process was abandoned about 25 years ago. In 1842-1849 the district Podlesie was developed in post-forest areas (the area of 362 ha), where are localities with historical names Kamionna, Podlesie and Cegielnia. In the years 1857-1860 the district Zielona Łąka (Green Meadow) was developed (the area of 196 ha). The main rivers of the Tuchola Forest, Brda and Wda rivers, were used for meadow irrigation. Waters from these rivers fed irrigation canals, built specially for that purpose: Czarnowodzki Canal – delivering water for irrigation of the Podlesie meadows, the Great and Small Brda Canals – feeding several areas, including the district Green Meadow. The phenomenon on European scale is the fact of water distribution throughout the meadows along the system of canals, ditches and flood furrows, creating the unique irrigation system referred to as strip-flood system or flood system. This infrastructure, in spite of considerable devastation, is still preserved and mostly functions continuously to the present day.

The areas of Czersk Meadows, irrigated continuously with the strip-flood system for more than 150 years, are covered by assemblages that from the phytosociological point of view are different subtypes of ryegrass meadows from the class *Molinio-Arrherenatheretea* R.Tx. 1937. On the treatment Green Meadow, as a result of abandoning irrigation, meadows of the ryegrass type were formed, largely transformed into the association of *Diantho-Armerietum* Krausch 1959 with the predominance of sheep's fescue. These psammophile communities belong to the class *Koelerio Glaucae-Corynephoretetea canescentis.* Three areas were selected in each meadow treatment, treating them as transects. Places for soil sample collection from surface and subsurface genetic horizons, i.e. A, AE, Bsv, were set in each of them at distances of 5 m, 15 m and 25 m from irrigation ditches. Samples were collected from 18 standard soil open pits. The example of a soil profile was presented in Fig. 1.

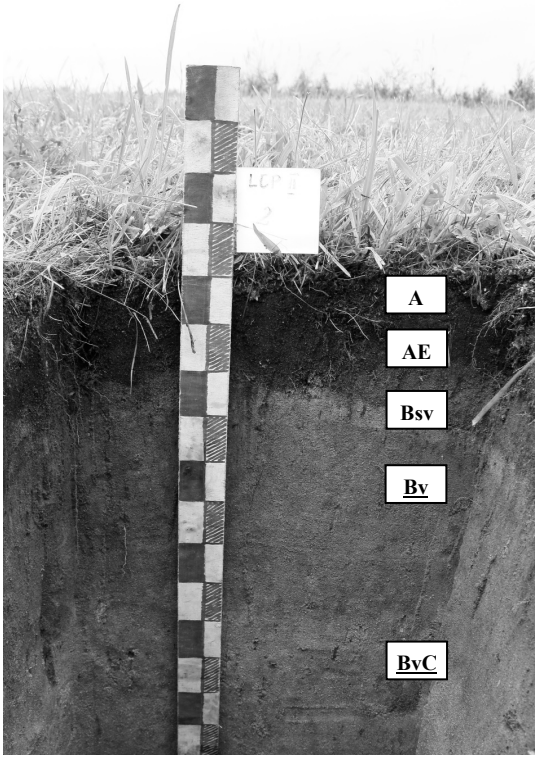

Fig. 1. Profile of rusty soil with features of podsolization (RWbi) – treatment Czersk Meadows – transect II – the distance from a ditch 15 m

Rys. 1. Profil gleby rdzawej z cechami bielicowania (RWbi) – obiekt Łąki Czerskie – transekt II – odległość od rowu 15 m

Methods of the study

In soil samples were determined as follows:

- pH with potentiometric method in suspension at the air dry soil to water ratio of 1:2.5 (w/v) [Mocek *et al*. 1997],
- the total content of organic carbon (TOC) and total nitrogen (Nt). TOC was calculated from the difference between the total carbon and inorganic carbon. Carbon and total nitrogen were determined with the analyser Vario Max CNS by Elementar (Germany) which uses the high-temperature burning in a pipe with oxygen proportioning. Generated gases that are the product of burning were purified from disturbing gases not subject to determination (e.g. volatile Cl, Br, I and At.) Particular components subject to determination were separated from one another with the use of special adsorption columns and they were determined one after the other in a sequencing manner in the thermal conductivity detector (TCD). The content of inorganic carbon was determined with the TOC analyser Primacs made by Skalar (Breda, the Netherlands) equipped with a low-temperature reactor, where a sample is treated with tetraoxophosphoric (V) acid, and the amount of generated CO_2 is determined in the IR detector,

– the contents of soluble organic matter (DOC) and nitrogen (DNt). Extraction was performed using 0.004 M $CaCl_2$ at the soil to extraction solvent ratio of 1:10 (w/v). Soil samples were shaken for 1 hour, then poured into centrifuge tubes and centrifuged. The suspension was pour off from above the sediment and in suspensions after extraction and the contents of carbon (DOC) and nitrogen (DNt) were determined with the Multi N/C 3100 Analityk Jena analyser (Breda, the Netherlands) and expressed in $mg \cdot kg^{-1}$ D.M. of the soil sample and as the percentage in the pool of TOC (Nt) [Gonet *et al*. 2002].

Statistical analysis of the results was performed at two stages. At the first stage, the ANOVA module in the packet Statistica 7.1 was used. All the results were presented graphically in triple interaction charts, and the variation within transects is presented by the range of standard error of weighted means. At the second stage of the analysis, in order to find the common interaction of treatments and factors on the research features, cluster analysis of the treatments was performed in respect of the highest probability of feature values in clusters. Data clustering was performed with the Ward method after previous data standardization. Statistical calculations were also made with the program Statistica 7.1.

RESULTS AND DISCUSSION

The soils of the complex Green Meadow, not irrigated for 25 years, were characterized by pH values in A horizon ranging from 5.2 to 6.5, and in the irrigated complex, from 5.3 to 6.9. Changes in the pH value in direction from acid to neutral along with the depth was observed in the studied soils. According to Jadczyszyn *et al*. [2010], the soil pH values staying within the range 5.5-6.5 are optimal for meadow and grassland vegetation.

The contents of organic carbon (TOC) that were obtained for soil samples collected in the area of not irrigated treatment (Green Meadow) were presented in Fig. 2. The results of statistical analysis indicated a significant effect of the depth of collecting samples on the content of TOC. The illuvial soil horizon was characterized by the lowest contents of total organic carbon in the soil samples in question, and humic horizon – by the highest. It was also found that the TOC content in A horizon slightly increased along with the distance from the irrigation ditch (Fig 2). In Bsv horizon, in turn, a small decrease in the content of this element along with the distance was obtained. The relationships similar to organic carbon content in the studied soils were found for the total nitrogen content (Nt). The A horizon of soils was characterized by significantly higher Nt contents in the soil samples of the treatment in question as compared with AE and Bsv horizons (Fig. 3).

Long-term irrigation with the strip-flood system in Czersk Meadows resulted in a completely different distribution of TOC and Nt contents in soil profiles than in the treatment Green Meadow. Surface meadow irrigation caused that the eluvial-humic soil horizon (AE) was the horizon with the highest content of organic carbon and total nitrogen, and the humic horizon – with the lowest (Figs. 2 and 3).

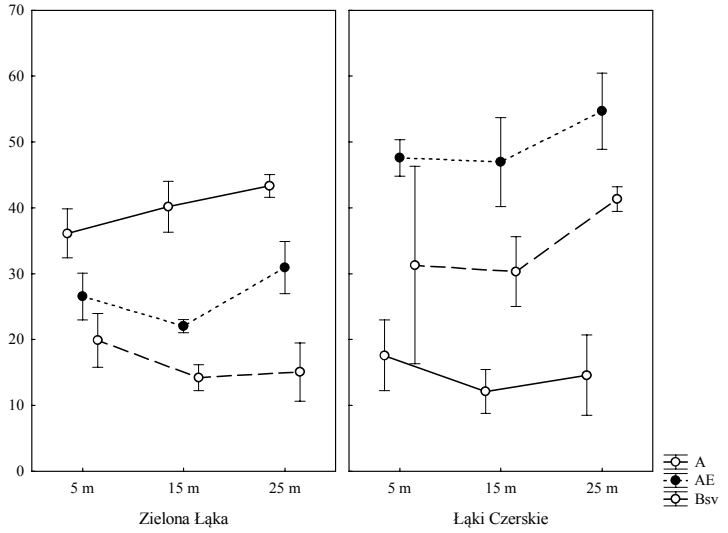

Fig. 2. TOC content in soil [g·kg^{-1}] depending on the distance from a watercourse [m] in genetic soil horizons

Rys. 2. Zawartość TOC w glebie [g·kg^{-1}] w zależności od odległości od cieku wodnego [m] w poziomach genetycznych gleb

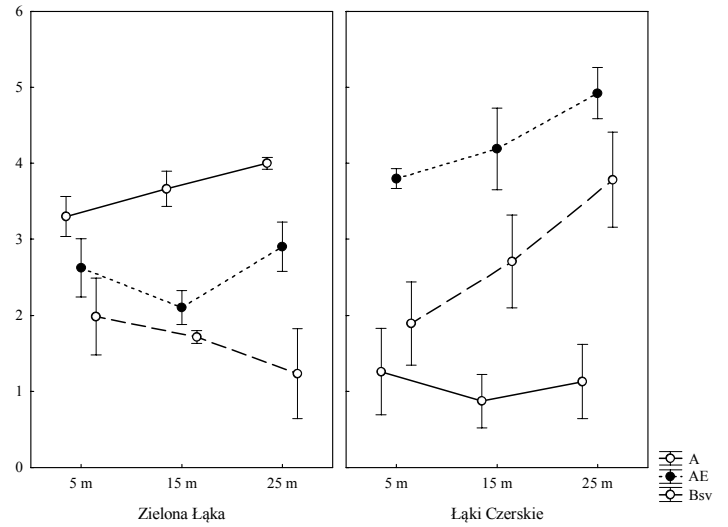

Fig. 3. Nt content in soil [g·kg^{-1}] depending on the distance from a watercourse [m] in genetic soil horizons

Rys. 3. Zawartość Nt w glebie [g·kg^{-1}] w zależności od odległości od cieku wodnego [m] w poziomach genetycznych gleb

It is worthy of note that irrespectively of the management method, particular genetic soil horizons were characterized by the highest TOC and Nt accumulation in the places most distant from the irrigation ditch. Based on the obtained results, it was also stated that the soils in the area of Czersk Meadows were characterized by a wider range of

organic carbon and total nitrogen contents in genetic horizons, which is well illustrated in Figs. 2 and 3. The obtained results confirm that the sward process occurring in meadow soils contributes to an increase in organic matter content in the upper profiles of those soils, which confirms the relationships obtained by Corré *et al*. [2000].

The changes in organic carbon and total nitrogen consequently result in the obtained TOC/Nt values (Fig. 4). The soil samples collected in the treatment Green Meadow did not differ statistically in the values of this ratio, except for Bsv horizon soil samples collected at distances of 15 and 25 m. The significantly higher TOC/Nt value that was obtained for this genetic horizon at a distance of 25 may be the consequence of a low content of nitrogen (Fig. 4). Also the soil samples collected in the area of the treatment Czersk Meadows did not show significant differences of this parameter (Fig. 4). It was found, however, that the soils of Czersk Meadows were characterized by a considerably wider TOC/Nt ratio. The lower TOC/Nt values which were obtained in the soil samples collected in Green Meadow can indicate a more intensive course of mineralization than in soils of Czersk Meadows [Gonet 2007]. It was also found that more intensive process of organic matter mineralization on the treatments where irrigation was abandoned (Green Meadow) occurs in surface horizon, i.e. humic (A) and humic-eluvial (AE). On the continuously irrigated treatments, the process of mineralization occurs mostly in deeper horizons: humic-eluvial (AE) and illuvial (Bsv), particularly in places more distant from irrigation ditches. Moreover, in conditions of continuous irrigation of meadows, the highest values of the TOC/Nt ration were obtained for soil samples collected closest to the irrigation ditches. It was also found that the values of this ratio which were obtained for individual genetic soil horizons of the treatment in question decreased along with the distance from the irrigation ditch (Fig. 4).

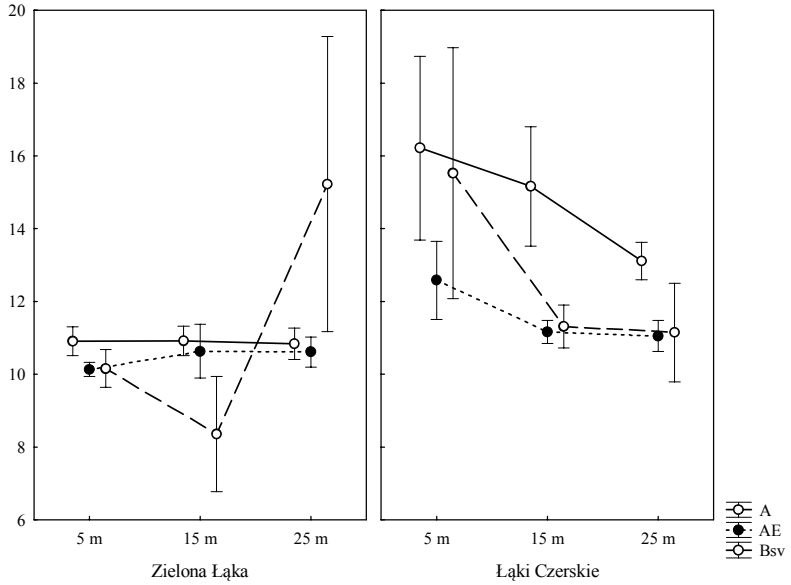

Fig. 4. Value of the TOC/Nt ratio depending on the distance from a watercourse [m] in genetic soil horizons

Rys. 4. Wartość stosunku TOC/Nt w zależności od odległości od cieku wodnego [m] w poziomach genetycznych gleb

One of the most essential fractions of organic matter is the water-soluble fraction. Their amount is determined based on the dissolved organic carbon (DOC). This fraction is the most mobile fraction of soil organic matter and it plays a crucial role in the soil environment. Its vital role is not only due to the fact that it can be easily leached into deeper soil layers, actively participates in the cycles of carbon and nitrogen circulation and is easily accessible for microorganisms. This carbon fraction can also transport nitrogen, mostly amine, providing the substrate for nitrification process [Gonet *et al*. 2002].

Figures 5 and 6 present mean contents of dissolved organic carbon (DOC) and dissolved nitrogen (DNt). Irrespective of the way of meadow management, particular genetic horizons differed statistically significantly in respect of the content of this organic carbon fraction. It was also found that the soil samples collected from A horizons were characterized by the highest contents (concentrations) of DOC, and those collected from Bsv horizons by the lowest (Figs. 5 and 6). Similarly to dissolved organic carbon, the lowest contents of dissolved nitrogen were obtained in the soil samples of iluvial horizons, and the highest in humic horizons. Moreover, the contents of DNt decreased along with the depths of soil sample collection, and the contents of DOC in particular genetic horizons on the treatment which was continuously irrigated increased along with the distance from the water course (Figs. 5 and 6).

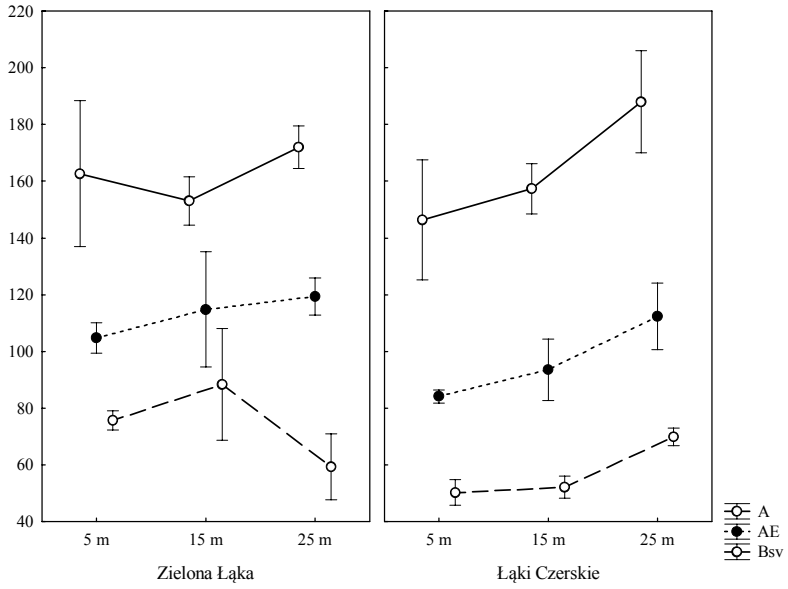

Fig. 5. DOC content in soil [mg·kg^{-1}] depending on the distance from a watercourse [m] in genetic soil horizons

Rys.5. Zawartość DOC w glebie [mg·kg^{-1}] w zależności od odległości od cieku wodnego [m] w poziomach genetycznych gleb

Irrespective of the way of meadow management, significant differences in the content of dissolved organic carbon (DOC) and dissolved nitrogen (DNt) were obtained in particular genetic soil horizons. The soil samples collected from humic horizons were characterized with the highest concentrations of the fractions in question, and those

from illuvial horizons – by the lowest. Moreover, the soils of continuously irrigated meadows were characterized by an increase in DOC and DNt contents along with the distance from the irrigation ditch – particularly in A and AE horizons.

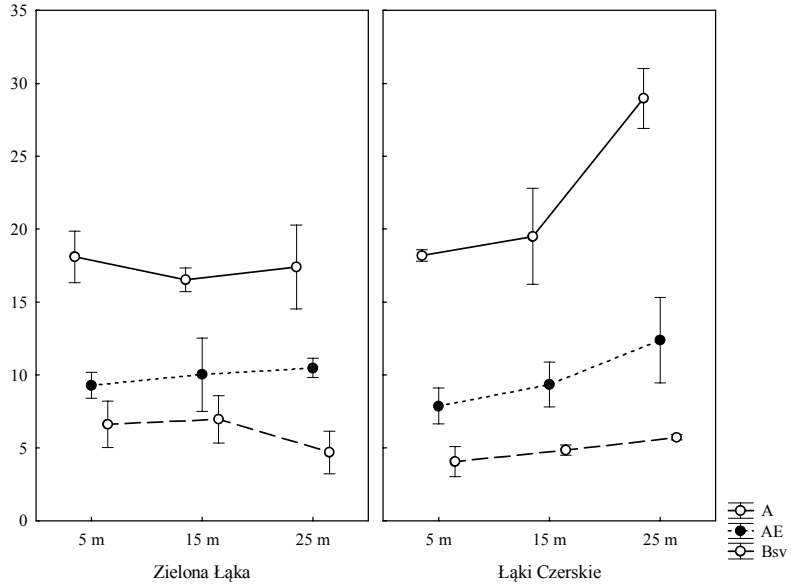

Fig. 6. DNt content in soil [mg·kg^{-1}] depending on the distance from a watercourse [m] in genetic soil horizons

Rys. 6. Zawartość DNt w glebie [mg·kg^{-1}] w zależności od odległości od cieku wodnego [m] w poziomach genetycznych gleb

Mean proportions of dissolved organic carbon in the pool of TOC in particular genetic horizons of soils collected in the area of the not irrigated treatment Green Meadow did not differ statistically and stayed within the range from 0.39 to 0.62% (Fig. 6). By contrast, in meadows that were irrigated for a long time and continuously, significantly higher mean proportions of this carbon fraction were obtained in A horizons of the soils and lower – with similar values – in deeper horizons (Fig. 7). Moreover, an intensive increase in the DOC proportion along with the distance from the irrigation ditch was observed in the humic soil horizons of Czersk Meadows. The high proportion of this carbon fraction in A horizons of soils continuously irrigated with the strip-flood system may be connected with leaching soluble organic matter out of the meadow sward. The studies by Weil and Magdoff [2004], Zaujec [2001] and Zsolnay [2001] indicate that in meadow soils mobile DOM compounds can be leached deep into the soil profile and to ground waters. Therefore, dissolved organic carbon is a sensitive indicator of changes occurring in the soil environment. The probable effect of leaching DOM deep into the soil profile was distinctly observed while comparing the meadow treatments irrigated systematically (Czersk Meadows) with the treatments where irrigation was abandoned (Green Meadow) (Fig. 7). Also Czaplak and Dembek [2000] proved a high proportion of dissolved organic carbon in the humic horizons of continuously irrigated meadows. The authors claim that this is the consequence of

smaller carbon losses, both in the form of CO_2 and the mobile fraction, resulting from a high ground water level due to irrigation.

The mean proportion of DNt which was obtained in soil samples of Czersk Meadows collected from AE i Bsv horizons was similar to the mean proportion of DOC on this treatment. Humic soil horizons were characterized by significantly higher proportions of this nitrogen fraction (Fig. 7). Similarly to the case of proportion of DOC, the mean proportion of DNt in A horizons of the soils increased along with the distance from the irrigation ditch. By contrast, in soil samples collected in Green Meadow, where irrigation was abandoned, no significant differences were found in proportions of this nitrogen fraction.

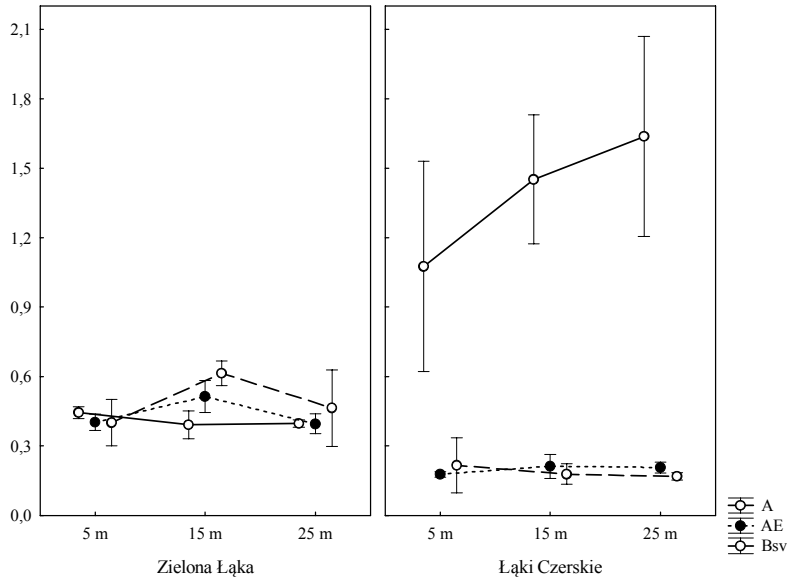

Fig. 7. DOC percentage in the TOC pool [%] depending on the distance from a watercourse [m] in genetic soil horizons

Rys. 7. Udział DOC w puli TOC [%] w zależności od odległości od cieku wodnego [m] w poziomach genetycznych gleb

Based on the results of conglomeration analysis made using the data after standardization (the contents of TOC, Nt, DOC and DNt) for treatments Green Meadow and Czersk Meadows altogether, a high variation of mutual relationships was observed (Table 1). The soils of meadows where irrigation was abandoned were characterized by the highest contents of TOC, Nt, DOC and DNt in the surface level of soils (A). The values of those parameters decreased with the depth of soil profiles. In contrast, on the treatment which was constantly irrigated (Czersk Meadows), the deeper, humic-eluvial soil horizon was characterized by the highest contents of TOC and Nt in soil samples, and the humic soil horizon and the humic soil horizon by the lowest. It is notable that the contents of DOC and DNt in systematically irrigated soils are similar to those where irrigation was abandoned. The highest values of DOC and DNt were found in A horizon of the soils and the lowest in Bsv horizon.

Table 1. Cluster composition and data clustering values in the studied treatments – real data
Tabela 1. Skład skupień i wartości cech w skupieniach próchnicy w badanych obiektach – dane rzeczywiste

Meadow association Zespół łąk	Cluster no Nr Skupienia	Symbol of treatment Symbol obiektu		TOC $g \cdot kg^{-1}$	Nt $g \cdot kg^{-1}$	DOC $mg \cdot kg^{-1}$	DNt $mg \cdot kg^{-1}$
		B	C				
Green Meadow A1 Zielona łąka A1	1	1	1	39.9	3.7	162.6	17.3
		2	1				
		3	1				
	2	1	2	28.7	2.8	112.0	9.9
		3	2				
	3	1	3	17.8	1.8	84.5	7.1
		2	2				
		2	3				
		3	3				
Czersk Meadows A2 Łąki Czerskie A2	1	1	1	14.8	1.1	163.9	22.2
		2	1				
		3	1				
	2	1	2	47.7	4.2	89.9	8.8
		2	2				
		3	2				
		3	3				
	3	1	3	30.8	2.3	51.1	4.4
		2	3				
Mean – Średnia				30.3	2.7	111.3	11.7

B – distance from the watercourse – odległość od cieku: 1 – 5 m, 2 – 15 m, 3 – 25 m
C – genetic soil horizon – poziom genetyczny gleby: 1 – A, 2 – AE, 3 – Bsv

CONCLUSIONS

1. Soils of meadows irrigated with the strip-flood system were characterized with a higher accumulation of organic carbon and total nitrogen in the humic soil horizon as compared with the soils of meadows, where irrigation was abandoned. Moreover, the contents of total organic carbon and total nitrogen in the soils of Czersk Meadows increased along with the distance from irrigation ditches.

2. Systematic irrigation of meadows was connected with the highest concentration of carbon and nitrogen in the humic-eluvial soil horizon. Abandoning irrigation had an effect on carbon and nitrogen mostly in the humus layer and a decrease in their value along with the depth.

3. Process of organic matter mineralization occurred more intensively on meadows which were no longer irrigated, which is indicated by the obtained values of the TOC/Nt relationship.

4. Long-term soil irrigation in Czersk Meadows affected the proportion of dissolved organic carbon and dissolved nitrogen. The humic soil horizon was characterized by a significantly higher proportion of these organic matter fractions as compared with the deeper horizons.

ACKNOWLEDGMENTS

The study comprising the results of a study conducted in 2011-2013 from the topic "The effects of long-term irrigation of permanent grasslands on the state of vegetation and properties of humus", founded by the Committee for Scientific Research (KBN) within the frame of research project no. N N310 104739.

REFERENCES

Corré, W.J., Sapek, B., Sapek, A. (2000). Concentration of oxygen, nitrous oxide and carbon dioxide in the soil as a function of soil pH and nitrogen fertilization. [In:] O. Oenema, A. Sapek (eds.), Effect of liming and nitrogen fertilizer application on soil acidity and gaseous nitrogen oxide emissions in grassland systems. Falenty IMUZ Publisher, 38-44.

Czaplak, I., Dembek, W. (2000). Torfowiska Polski jako źródło emisji dwutlenku węgla. Zesz. Edukacyjne, 6, 61-70.

Doran, J.W., Parkin, T.B. (1994). Defining and assessing soil quality. [In:] J.W. Doran, D.C. Coleman, D.F. Bezdicek, B.A. Stewart (eds.), Defining soil quality for a sustainable environment. Madison, WI: SSSA Special Publication 35, Soil Sci. Sot. Amer.: Amer. Sot. Agron., 3-21.

Fotyma, M., Mercik, S., Faber A. (1987). Chemiczne podstawy żyzności gleb i nawożenia. PWRiL Warszawa.

Gonet, S.S. (2007). Ochrona zasobów materii organicznej gleb. [In:] S.S. Gonet, M. Markiewicz (eds.), Rola materii organicznej w środowisku. PTSH, Wroclaw, Poland, 7-29.

Gonet, S.S., Debska, B., Pakula, J. (2002). The content of the dissolved organic carbon in soils and organic fertilizers. PTSH Wrocław, Poland.

Jadczyszyn, T., Kowalczyk, J., Lipiński, W. (2010). Zalecenia nawozowe dla roślin uprawy polowej i trwałych użytków zielonych. IUNG-PIB Puławy, Materiały szkoleniowe, 95, 24.

Mazur, T. ed. (1991). Azot w glebach uprawnych. PWN Warszawa.

Mocek, A., Drzymała, S., Maszner, P. (1997). Geneza, analiza i klasyfikacja gleb. AR Poznań.

Robinson, C.A., Cruse, R.M., Kohler, K.A. (1994). Soil management. [In:] J.L. Hatfield, D.L. Karlen (eds.), Boca Raton, Sustainable agriculture systems. FL: Lewis Publ., 109-134.

Sabiniarz, A. (2006). Łąki Czerskie w aspekcie historycznym. Łąkarstwo w Polsce, 9, 184-194.

Sapek, B. (2009). Zapobieganie stratom i sekwestracja węgla organicznego w glebach łąkowych. Inż. Ekol. 21, 48-61.

Takeda, H. (1998). Decomposition processes of litter along a latitudinal gradient. [In:] Environmental forest science (ed.) K. Sassa, Kluwer Academic Press, Dordrecht, 197-206.

UNEP Year Book (2012). Emerging Issues in our Global Environment. UNEP, 80.

Weil, R.R., Magdoff, F. (2004). Significance of soil organic matter to soil quality and health. [In:] F. Magdoff, R.R. Weil (eds.), Soil organic matter in sustainable agriculture, CRC Press London.

World Reference Base for Soil Resources. Food and Agriculture Organization of the United Nations (2006). World Soil Resources Reports 103. FAO Rome, 132.

Zaujec, A. (2001). Soil organic matter as indicator of soil quality and human influences on agroecosystems and natural forest ecosystem. [In:] J. Sobocka (ed.), Soil Anthropization VI. Proceedings, International Workshop Bratislava, Slovakia, 165-174.

Zsolnay, A. (2001). The prediction of the environmental function of the dissolved organic matter (DOM) in ecosystems. ESF Exploratory Workshop, Beilngries, Germany. Scientific Report, 1-18.

WPŁYW DŁUGOTRWAŁEGO NAWADNIANIA ŁĄK NA STAN MATERII ORGANICZNEJ

Streszczenie. Kompleks Łąk Czerskich, nawadniany od połowy XIX wieku systemem stokowo-zalewowym, jest unikatowy w skali europejskiej. Celem badań było określenie zawartości węgla organicznego, azotu ogółem i frakcji rozpuszczalnej materii organicznej w warunkach długotrwałego nawadniania użytków zielonych. Badano obszary Łąk Czerskich nawadniane od ponad 150 lat i takie, które ponad 25 lat temu zaprzestano nawadniać (Zielona Łąka). Na badanym obszarze występują gleby rdzawe z cechami bielicowania (RWbi – *Albic Brunic Arenosols* (*Distric*)). Próbki gleb pobrano z poziomów powierzchniowych i podpowierzchniowych: A, AE, Bsv. Oznaczono: zawartość węgla organicznego (TOC), azotu ogółem (Nt) oraz dissolved organic carbon (DOC) i dissolved nitrogen (DNt). Stwierdzono większą kumulację węgla organicznego i azotu ogółem w poziomie próchnicznym gleb łąk systematycznie nawadnianych w porównaniu z glebami łąk, które zaprzestano nawadniać. Zawartości TOC i Nt w próbkach gleb pobranych na Łąkach Czerskich zwiększały się wraz z odległością od rowów nawadniających. Gleby łąk nawadnianych charakteryzowały się szerszym stosunkiem TOC/Nt niż gleby łąk nienawadnianych. Wynikiem stałego nawadniania łąk był też wysoki udział DOC i DNt w poziomie próchnicznym (A) gleb.

Słowa kluczowe: gleby rdzawe, total organic carbon, total nitrogen, dissolved organic carbon, dissolved nitrogen, nawadnianie systemem stokowo-zalewowym

Accepted for print – Zaakceptowano do druku: 20.04.2015

For citation – Do cytowania:

Dziamski, A., Banach-Szott, M., Dębska, B. (2015). The effect of long-term irrigation of meadows on the state of organic matter. Acta Sci. Pol. Agricultura, 14(2), 15-27.