

EFFECT OF DIFFERENT METHODS OF MANAGEMENT OF POST CLEAR CUTTING RESIDUES ON SOIL CARBON CONTENT

Stanisław Gałązka, Roman Gornowicz, Zenon Pilarek
Agricultural University of Poznań

Abstract. Forests play a very important role in the process of the carbon cycle in the natural environment and timber harvesting disturbs the natural circulation of this element considerably. Moreover, the way of handling the post clear cutting residues can also influence the accumulation of carbon in the soil. Usually, increased contents of organic carbon in the near-surface layers of mineral forest soils were observed in the first year following the stand removal. The greatest soil carbon enrichment was recorded when branches were ground and mixed with the mineral soil. Considerable variations in the observed contents of organic carbon in the near-surface layer of mineral soils during the first two years after clear cutting and later makes it impossible to indicate the most advantageous method of management of post clear cutting residues.

Key words: Scots pine, organic carbon

INTRODUCTION

The Climatic Change Convention as well as the Kyoto Protocol specify actions intensifying the process of carbon fixation. Forests play a particularly important role in this regard, and forest soils provide an important reservoir of this element.

Carbon is accumulated, primarily, in the organic horizon characteristic for forest soils and, in the mineral part of the soil profile, it is accumulated in the humus horizon. The goal of the presented work was to determine to what extent the establishment of the cutting area as well as the applied different management methods of felling residues influence the carbon contents in the near-surface layer of mineral soil.

OBJECT AND RESEARCH METHODS

Investigations were conducted on an experimental surface situated in Kalisz Pomorski Forest District in Piła Regional Directorate of State Forests (RDSF). From the point

Corresponding author – Adres do korespondencji: Dr inż. Stanisław Gałązka, Department of Natural Bases of Forestry of Agricultural University of Poznań, Górska 3, 60-623 Poznań, Poland.

of view of typology, the experimental object corresponds to fresh coniferous forest site (Bśw) with Leucobryo-Pinetum association. The soils of the experimental plot developed from fluvial-glacial deposits [Galon 1974] and the operating soil-forming factors gave them brown podzolic character [Biały et al. 2000].

Three felling plots were selected to realize the research objective from which soil samples were collected from the mineral layer extending from 0-20 cm. After felling the stand, defined areas were marked off on each experimental plot on which the remaining branches and twigs were: removed, burnt, left intact, ground or after grinding mixed with the surface layer of soil. Soil samples for laboratory analyses were initially collected every three months and, later on, once a year after the end of the vegetative season. The authors employed the Tiurin method to determine the content of organic carbon in the collected soil samples [Ostrowska et al. 2001].

RESULTS

The complete removal of the existing stand and the application of different management methods of felling residues, as a rule, resulted in a distinct increase in the content of organic carbon in the 0-20 cm layer of mineral soil which comprised the soil humus horizon of the examined surfaces.

The dynamics of changes became particularly apparent in the year following the removal of the stand, as confirmed by the obtained results concerning the short quarterly periods (Table 1).

Table 1. Changes in the organic carbon content in the top soil layer in relation to the management method of felling residues in the first year after the removal of stand.

Tabela 1. Zmiany zawartości węgla organicznego w wierzchniej warstwie gleb w zależności od metody zagospodarowania pozostałości zrębowych w pierwszym roku po usunięciu drzewostanu

| Management method of felling residues Metoda zagospodarowania pozostałości zrębowych | 4th quarter of 1998 "0" IV kwartał 1998 „0” | 1st quarter of 1999 I kwartał 1999 | 2nd quarter of 1999 II kwartał 1999 | 3rd quarter of 1999 III kwartał 1999 | 4th quarter of 1999 IV kwartał 1999 |
|----------------------------------------------------------------------------------------------------|------------------------------------------------|---------------------------------------|----------------------------------------|-----------------------------------------|----------------------------------------|
| Removal of residues Wyniesienie pozostałości | 1.680 | 1.745 | 1.994 | 2.492 | 0.546 |
| Burning on soil surface Spalenie na powierzchni | 1.680 | 2.064 | 2.359 | 2.949 | 2.066 |
| Leaving residues intact on soil surface Pozostawienie w całości na powierzchni | 1.680 | 2.476 | 2.830 | 3.537 | 1.097 |
| Chipping of residues Rozdrobnienie pozostałości | 1.680 | 1.278 | 1.461 | 1.826 | 0.972 |
| Chipping of residues and mixing them with soil Rozdrobnienie pozostałości i wymieszanie z glebą | 1.680 | 2.626 | 2.507 | 4.387 | 2.494 |

From all the methods of handling the post-felling area applied in this experiment, the method where branches were ground and mixed with the surface soil layer deserves particular attention. In the case of this treatment, the highest increases of organic carbon were recorded which, in the third quarter after the removal of the stand, exceeded over 2.5 times the quantities of carbon determined in soil samples before felling operations.

A significant increase in the organic carbon content in the surface, humic-mineral soil layer was also determined in the treatment where branches were burnt or left intact on the soil surface after felling (Table 1).

The content of organic carbon was found elevated even in the case of the felling plot from which the branches were removed altogether, although in this case this increase was much lower.

During the consecutive research periods, the content of organic carbon clearly decreased to the value lower than at the beginning of the experiment (Table 1). The quantities of this component occurring in the near-surface soil layer during this period were distinctly less dependent on different management methods of post felling residues employed in this study.

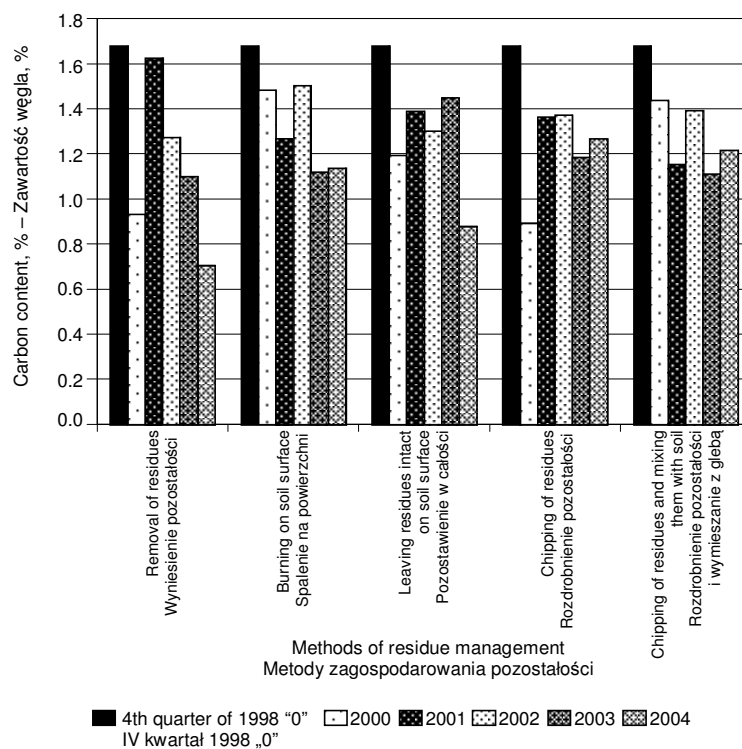


Fig. 1. Changes in the organic carbon content in the top soil layer in relation to the management method of felling residues in the consecutive periods of experiment

Rys. 1. Zmiany zawartości węgla organicznego w wierzchniej warstwie gleb w zależności od metody zagospodarowania pozostałości zrębowych w kolejnych okresach badawczych

Nevertheless, the occurring trends indicate that the complete removal of branches from the felled surface as well as burning branches led to the impoverishment of the examined soil layer in organic carbon.

The chopping of branches and leaving the chopped material on the soil surface forming a compact layer of organic matter turned out to be the only treatment which failed to increase the content of organic carbon in the examined soil layer following the removal of the stand.

The experimental treatments in which intact branches were left on the felling area, ground and mixed with the surface soil layer or ground and left on the surface all created similar conditions for organic carbon accumulation in the soil during the successive experimental periods (Fig. 1).

Bearing in mind huge organic carbon reserves accumulated in the organic matter left on the surface of felled areas in the form of branches or chips, enormous possibilities of forest soils in carbon fixing should not be underestimated.

CONCLUSIONS

The obtained research results allowed the authors to put forward the following generalizations:

Increased content of organic carbon in the near-surface layer of forest mineral soils usually took place in the first year after the removal of the stand and its quantity depended on the management method of felling residues.

The chipping of branches and mixing the chips with soil enriched the mineral soil in organic carbon most during the first year of experiments.

The smallest quantitative differences in the occurrence of organic carbon during the entire period of studies were observed in the treatment when branches were ground and left on the surface.

A considerable variability in the organic carbon content in the near-surface layer of mineral soil observed during the consecutive years of experiment (two years after clear cutting and later) makes it impossible to indicate the most advantageous management method of felling residues.

The biomass of felling residues accumulated in forest soils plays an important role in the process of carbon fixing.

REFERENCES

- Biały Z., Brożek S., Chojnicki J., Czempińska-Kamińska D., Januszek K., Krzyżanowski A., Okołowicz M., Sienkiewicz A., Skiba S., Wójcik J., Zielony R., 2000. Klasyfikacja gleb leśnych Polski [Classification of Polish forest soils]. Centr. Inf. Lasów Państw. Warszawa [in Polish].
- Galon R., 1972. Geomorfologia Polski. T. 2. Niż Polski [Geomorphology of Poland. Part 2. Polish Lowland]. PWN Warszawa [in Polish].
- Ostrowska A., Porębska G., Borzyszkowski J., Król H., Gawliński S., 2001. Właściwości gleb leśnych i metody ich oznaczania [Properties of forest soils and methods of their determination]. IOŚ Warszawa [in Polish].

WPLYW RÓŻNYCH SPOSOBÓW ZAGOSPODAROWANIA POZOSTAŁOŚCI ZRĘBOWYCH NA ZAWARTOŚĆ WĘGLA W GLEBIE

Streszczenie. Lasy odgrywają bardzo ważną rolę w procesie obiegu węgla w przyrodzie. Pozyskanie drewna w znaczący sposób zakłóca obieg tego pierwiastka. Także sposób postępowania z pozostałościami zrębowymi wpływa na kumulację węgla w glebie. Wzrost zawartości węgla organicznego w przypowierzchniowej warstwie mineralnej gleb leśnych następował zazwyczaj w pierwszym roku po usunięciu drzewostanu. W największym stopniu wzbogacenie gleb w węgiel następowało po rozdrobieniu gałęzi i wymieszaniu ich z glebą mineralną. Duże zróżnicowanie zawartości węgla organicznego w przypowierzchniowej warstwie mineralnej gleb, w okresie dwóch lat i późniejszym po wycięciu drzewostanu, nie pozwala wskazać najkorzystniejszego sposobu zagospodarowania pozostałości zrębowych.

Słowa kluczowe: sosna zwyczajna, węgiel organiczny

Accepted for print – Zaakceptowano do druku: 22.10.2007

For citation – Do cytowania: Gałzka S., Gornowicz R., Pilarek Z., 2007. Effect of different methods of management of post clear cutting residues on soil carbon content. Acta Sci. Pol., Silv. Colendar. Rat. Ind. Lignar. 6(4) 2007, 23-27.