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RELATIONSHIPS BETWEEN THE TRANSFORMATION OF ORGANIC COMPONENTS TO CARBON DIOXIDE EVOLUTION AND NITROGEN MINERALIZATION IN PEAT SOILS

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INTRODUCTION

The problem of an appropriate management und utilization systems of peat soils constituted the subject of an intensive research for over 100 years. The problem arose in connection with the necessity of developing new areas for agricultural production as well as the need to protect all peat soils against decomposition and the rapid loss of organic matter. To significant factors affecting phisical, chemical and biochemical changes in peat soils as well as decomposition of organic matter belong reclamation, tillage, crop rotations and fertilization [3, 9, 10].

It is generally believed that soils undergo the strongest humification and mineralization under the field crop production system and considerably less under the grassland system. This is due to the more intensive aeration of the peat soil profile under field conditions and the smaller accumulation of plant residues in case of the grassland system, especially in the upper layers of the soil profile. Under good aerobic conditions of decay the soil microorganisms quickly utilize more readily degradable materials converting them to carbon dioxide and mineral nitrogen or incorporating them into their own structural matter [11].

The resistant materials, particularly lignins and bitumens, tend to accumulate in peat soils [4, 9, 10]. Decomposition occurs parallelly to the peat-forming plant residues as well as the residues derived from the new plants resulting from crop production. The recent organic matter accumulates in the soil and probably affects the decomposition rate of the organic matter already present [11]. Under good climatic and aerobic conditions the amount of humic acids, total and mineral nitrogen as well as ash increase rapidly while the content of carbohydrates decreases. [4, 9, 10, 11].

In the paper its authors present the results of their studies concerning effects of a 25-year term and various agricultural systems of peat soil cultivation. Various biochemical changes in soils and their response to mineralization of organically bound carbon and nitrogen have been noted.

MATERIALS AND METHODS

Materials consisted of low peat soil samples taken from the depth of 5—10, 25—30, 55—60 and 95—100 cm on soil sites of the Peat Experiment Station Biebrza, Poland. The peat soils were used for the past 25 years (1957—1982) for grassland, field or alternate (fieldgrassland) cultivation with varying mineral fertilization. One of the peat soil sites was for 80 years under forest.

Utilization and treatments :

— grassland — O, K, PK, NPK,

— field – O, K, PK, NPK,

— alternate utilization (3 years field and 3 years grassland) — O, K, PK, NPK,

— forest — (one profile) — O.

Fertilization:

O — without fertilization,

K — 83 kg K per ha a year,

PK – 83 kg K, 22 kg P per ha a year,

NPK — 83 kg K, 22 kg P, 30 kg N per ha a year.

Plants in the alternate utilization: 1. potatoes, 2. hemp, 3. summer rye, 3 years grassland.

Plants in the field utilization: typical mixture of grasses adapted to peat-soil conditions.

Forest: peat soil under birch forest for about 80 years.

Analytical methods:

The peat kind and the peat decomposition degree (in fresh samples) was determined by the microscopic method, while the pH value (in H_2O) was measured potentiometrically.

Milled and sieved (ϕ 2 mm screen) air-dry peat soil samaples were used for further analyses.

Organic matter and ash contents were determined by burning peat samples at the temperature of 550°C.

Carbon content was determined by the dry combustion method and nitrogen — by the micro-Kjeldahl method.

Humus fractions were determined according to Kononova and Belchikova [8].

Carbohydrate (collulose and hemicellulose) — according to Stevenson [17].

Measurement of the CO_2 secretion was done after Norman and Newman [12]. Soil samples were incubated at 32°C in 1-liter bottles and the CO_2 secreted was absorbed in a 0.5 N NaOH solution. Periodical titration with 0.5 N HCl was carried out after the addition of an excess amount of 3 N $BaCl_2$ to determine the level of unneutralized NaOH.

The amount of CO_2 secreted from soil was calculated as the difference from the control.

Mineralization of nitrogen was determined after the Stanford and Hanway [16] technique of longterm incubation (at 32°C) with intermittent (2-week-intervals) leaching. Peat soil samples were sieved to aggregate size ± ϕ 4 mm. After each leaching procedure excess water was removed by means of the water jet pump at a suction of 0.5 bar. N—NH_4 and N—NO_3 as the final products of N-mineralization were determined after Bremner [2].

INVESTIGATION RESULTS

Some geobotanical and chemical properties of soils. The soils examined (mucky peats and peats) represented reclaimed low peat soils from north-eastern parts of Poland. Due to the source of the data (Table 1) the discussed peat soils are typical representatives of low peat soil profiles consisting mainly of sedge, reed or sedge-reed peat.

The pH values of the soils varied within the limits of 4.5—5.9. The pH of upper layers was usually less than 5.0. Systems of agricultural cultivation did nor affect the acidity of peat soils. The peat decomposition degree ranged from low (25%) trough medium (50%) to high (over 60%). Decomposition of peat organic matter often depends on the depth, with the upper layers of soil profiles, as a rule, often being more decomposed than deeper ones. The decomposition of the peat is also affected by the kind of peat and the crop production system.

As shown by the data presented in Table 1, the cultivated, grassland and forest soils are stronger decomposed than the other soils.

The long-term cultivation of soil, particularly of the grassland and forest sites, led to an increase of ash and a decrease of organic matter. This was observed particularly clearly in upper soil layers.

From the data presented graphically in Fig. 1 it can be observed that the greatest increase of the ash content occurred in unfertilized grassland soils and the same soils receiving additionally K. Significant increase of the ash content was also visible in unfertilized soils in the field and alternate utilization.

The lowest values of the ash content occurred in the PK-fertilized site. Fertilization decreased the average ash content in soil in all cases of the field cultivation...

Analyses of soil samples for the content of humic acid showed distinct differences depending on the decomposition of the soil organic matter and the cultivation system.

More humic acids were formed in the strongly decomposed (mostly) surface layers of soil profiles than from deeper layers. However, in some soils the deepest layers of the profile contained the greatest amount of humic acids. As presented in Fig. 1, the average content of humic acids

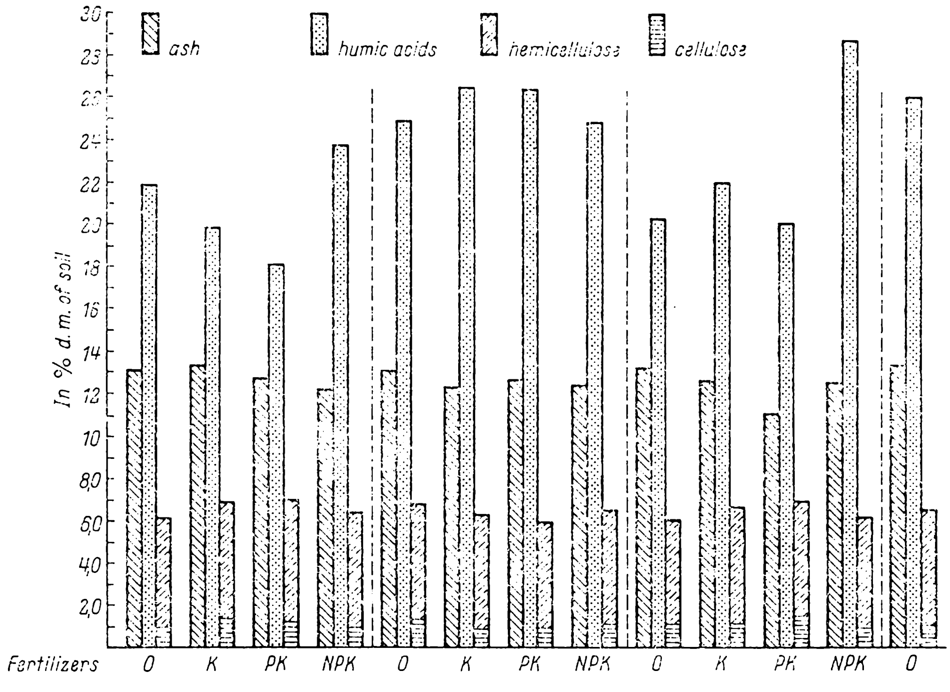

Fig. 1. Average content of ash, humic acids and carbohydrates in peat soil profiles

in soil depended on the cultivation and fertilization method. An intensive humification process took place in soils under alternate utilization, fertilized PK and K or unfertilized. However, the greatest average content of humic acids was noted in NPK-fertilized soils in the field or forest sites. Grassland soils fertilized showed also stronger humification than the other grassland soils.

It is clear from the data mentioned that nitrogen and NPK fertilization stimulates the humification process of peat soils. However, the effect of the remaining K and PK fertilizers is questionable.

The results of the analyses for carbohydrates (Table 1) indicate that the content of cellulose and hemicellulose in peat soils depends on the soil decomposition degree and the profile depth. The cllulose content varied within 0.33—2.05%, the hemicellulose content — within 3.16—8.58% of dry matter of soil. With regard to the total carbohydrate content, the lowest content of cellulose was found in upper layers as compared with deeper soil layers. Conversely, the highest content of hemicellulose was

Table 1

Analytical data of peat soils

Sample No.	Layer cm	pH	Kind of peat	Decomposition degree %	Ash	Organic matter	Humic acids	Carbohydrate cellulose	Carbohydrate hemicellulose	Carbohydrate total
					% of d.m.					
1	2	3	4	5	6	7	8	9	10	11
	Grassland site C									
1	5-10	4,9	muck	70	16,13	83,87	23,69	0,33	8,45	8,78
2	25-30	5,0	sedge-peat	40	9,46	90,54	20,27	1,51	5,03	6,54
3	55-60	5,0	reed-sedge peat	50	11,46	88,54	19,32	1,02	3,77	4,79
4	95-100	5,2	reed peat	60	15,33	84,67	23,80	1,07	3,16	4,23
	Grassland site K									
5	5-10	4,8	muck	70	14,63	85,37	24,21	0,94	8,24	9,18
6	25-30	5,1	sedge peat	35	11,96	88,84	13,99	1,53	5,97	7,50
7	55-60	5,2	reed-sedge peat	40	11,74	88,04	18,05	1,26	4,15	5,41
8	95-100	5,3	alder peat	45	15,02	84,93	23,11	1,48	3,88	5,37
	Grassland site PK									
9	5-10	5,1	muck	70	16,70	83,30	22,03	0,74	8,58	9,32
10	25-30	5,9	sedge peat	50	10,72	89,28	16,25	1,63	4,85	6,48
11	55-60	5,1	reed peat	40	12,98	87,02	21,20	0,95	4,50	5,45
12	95-100	5,2	reed peat	40	10,47	89,53	12,75	1,85	4,76	6,61
	Grassland site NPK									
13	5-10	4,8	muck	70	13,61	86,39	31,01	0,68	8,02	8,70
14	25-30	5,1	reed-sedge peat	40	10,43	89,52	23,50	0,46	5,87	6,33
15	55-60	5,2	reed peat	35	12,00	87,93	23,64	0,80	3,73	4,53
16	95-100	5,4	moss peat	25	12,83	87,17	16,70	1,57	4,39	5,96
	Alternate utilization site O									
17	5-10	4,9	sedge peat	60	14,43	84,57	26,67	0,56	8,07	8,63
18	25-30	5,0	sedge peat	40	13,20	86,80	22,49	1,52	5,61	7,13
19	55-60	4,9	reed-sedge peat	40	10,96	89,04	23,52	1,37	3,94	5,31
20	95-100	5,5	reed peat	45	13,32	86,68	26,85	1,57	4,42	5,99
	Alternate utilization site K									
21	5-10	4,8	sedge peat	55	14,38	85,62	29,57	0,97	8,05	9,02
22	25-30	4,9	sedge-moss peat	30	10,02	89,98	22,72	1,24	5,16	6,40
23	55-60	5,1	sedge peat	45	11,02	88,98	22,94	1,02	4,45	5,47
24	95-100	5,4	alder peat	60	13,51	86,49	31,01	0,43	3,70	4,13
	Alternate utilization site PK									
25	5-10	5,0	sedge-moss peat	45	13,00	87,00	25,80	0,51	7,03	7,54
26	25-30	5,3	sedge peat	35	14,33	85,67	19,35	0,88	5,05	5,93
27	55-60	5,2	sedge-reed peat	40	11,62	88,38	26,70	0,81	3,99	4,80
28	95-100	5,1	reed peat	45	11,51	88,49	33,52	1,31	3,99	5,30

Table 1 continued

1	2	3	4	5	6	7	8	9	10	11
	Alternate utilization site NPK									
29	5-10	4,9	sedge peat	60	13,88	86,12	30,51	0,92	6,32	7,24
30	25-30	5,2	sedge peat	50	10,92	89,08	24,48	1,07	7,00	8,07
31	55-60	5,2	sedge-reed peat	40	12,66	87,34	19,21	1,47	4,91	6,38
32	95-100	5,4	reed peat	60	21,59	78,41	14,78	0,78	3,72	4,50
	Field site O									
33	5-10	4,8	sedge peat	55	12,85	87,15	21,58	0,84	7,38	8,22
34	25-30	4,9	reed peat	50	10,74	89,26	16,34	1,07	5,45	6,52
35	55-60	5,1	sedge-reed peat	55	12,04	87,96	18,04	1,31	4,02	5,33
36	95-100	5,0	reed peat	70	17,09	88,91	24,89	1,05	3,23	4,28
	Field site K									
37	5-10	4,6	sedge peat	60	13,75	86,25	24,30	1,04	7,92	8,96
38	25-30	5,2	sedge peat	40	12,10	87,90	19,64	1,73	5,73	7,46
39	55-60	4,8	sedge-reed peat	35	10,43	89,57	19,03	0,85	4,85	5,70
40	95-100	5,4	reed peat	65	14,16	85,84	24,88	0,94	3,71	4,65
	Field site PK									
41	5-10	4,9	sedge peat	50	14,07	85,93	21,26	0,90	7,72	8,62
42	25-30	5,1	sedge-reed peat	40	9,05	90,95	16,96	2,12	4,98	7,10
43	55-60	5,0	sedge-reed peat	35	11,65	85,35	23,18	0,55	4,25	4,80
44	95-100	5,1	reed peat	45	9,77	90,23	20,16	2,05	5,57	5,62
	Field site NPK									
45	5-10	4,8	sedge peat	35	12,26	87,74	26,46	0,44	7,49	7,93
46	25-30	5,0	sedge peat	30	10,92	89,08	25,97	1,40	5,23	6,63
47	55-60	5,2	reed peat	40	11,91	88,09	31,68	0,24	4,34	4,58
48	95-100	4,9	alder peat	60	14,92	85,08	30,60	1,17	4,11	5,28
	Forest site O									
49	5-10	4,5	alder peat	60	15,07	84,93	31,05	0,59	7,40	7,99
50	25-30	4,9	alder peat	40	9,04	90,96	22,69	1,61	6,53	8,14
51	55-60	5,2	alder peat	50	10,21	89,79	20,08	1,07	4,45	5,52
52	95-100	5,4	alder peat	60	19,85	80,15	30,00	0,55	3,66	4,21

in upper soil layers with a distinct decrease down the profile. This is opposite to the cellulose content, which was very low in upper soil layers and increased down the profile.

The above differences are affected further by cultivation. As given in Table 1, the total carbohydrate content varies in upper layers of soil from 7.24 to 9.32% of dry matter. The lowest values of carbohydrates (about 4.13%) were noted in the deepest soil layers.

The data presented prove (Fig. 1) that soils fertilized with K and PK under grassland and field utilization are richest in carbohydrates. The lowest values of carbohydrates were found in unfertilized soils and field soils receiving additionally NPK. The PK-fertilized soil under alternate utilization contained also low carbohydrate amounts. As shown in Fig. 1, a decrease of the carbohydrate level resulted often in increased level of humic acids in the soils investigated.

Significant elements characteristic for particular soil-forming processes of the profile, include differences in the total carbon and nitrogen content (Table 2).

Table 2

Carbon and nitrogen content and ratio of some components of peat soil

Sample No.	C %	Total N of d.m.	$\frac{C}{N}$	$\frac{Hemicellulose}{Cellulose}$	$\frac{CO_2/evol./}{N\ /min/}$	$\frac{Total\ carbohydrate}{CO_2\ /evol./}$	$\frac{N-NO_3}{N-NH_4}$
1	2	3	4	5	6	7	8
	Grassland site O						
1	44,29	4,43	9,99	25,44	4,05	4,56	3,76
2	48,98	3,39	14,44	3,34	5,04	4,62	2,87
3	47,98	3,25	14,75	3,72	3,23	3,98	3,85
4	46,59	2,54	18,32	2,95	4,20	4,84	4,20
	Grassland site K						
5	46,90	3,96	11,84	8,79	7,28	4,60	2,97
6	48,80	3,39	14,40	3,90	5,83	4,95	4,66
7	47,46	3,33	14,24	3,28	6,08	4,07	3,14
8	52,28	2,66	19,62	2,62	3,90	5,60	3,27
	Grassland site PK						
9	48,87	4,16	11,74	11,53	4,91	4,65	4,07
10	49,45	3,28	15,07	2,97	6,59	4,02	4,17
11	50,70	3,58	14,17	4,71	5,96	3,66	2,23
12	48,69	2,66	18,30	2,58	4,57	7,67	5,42
	Grassland site NPK						
13	45,80	4,19	11,04	11,79	6,75	3,59	4,35
14	49,23	3,80	12,95	12,88	8,01	3,34	2,70
15	46,31	3,54	13,06	4,64	5,23	2,79	7,18
16	44,69	2,82	19,39	2,80	7,38	4,09	8,61
	Alternate utilization site O						
17	44,27	4,11	10,77	14,35	7,36	4,14	2,64
18	52,19	3,37	15,48	6,68	6,03	6,08	2,81
19	48,69	3,70	13,14	2,87	3,25	4,59	4,91
20	50,06	2,87	17,43	2,82	4,70	6,27	2,42
	Alternate utilization site K						
21	43,47	3,73	11,66	8,33	6,07	4,52	0,72
22	47,47	3,69	13,02	4,16	6,13	4,97	1,25
23	49,92	3,73	13,37	4,38	3,23	4,28	4,08
24	45,13	2,91	15,52	8,54	3,72	4,56	2,49
	Alternate utilization site PK						
25	45,98	3,77	12,05	13,72	7,25	3,53	5,22
26	47,53	3,47	13,51	5,73	5,67	3,35	19,80
27	48,10	3,37	14,25	4,95	4,80	2,75	6,91
28	49,09	2,91	16,85	3,04	6,96	4,38	11,45

1	2	3	4	5	6	7	8
	Alternate utilization site NPK						
29	47,20	4,18	11,28	6,90	10,78	3,49	2,09
30	48,91	3,23	15,14	6,52	6,06	4,78	2,58
31	46,20	3,47	13,29	3,35	5,27	3,74	7,10
32	43,13	1,92	22,42	4,74	6,81	3,16	2,12
	Field site O						
33	47,47	3,90	12,18	8,74	7,66	4,45	14,66
34	49,61	3,34	14,87	5,11	3,04	5,18	23,06
35	47,71	3,82	12,43	3,07	4,82	4,41	3,53
36	46,48	2,63	17,67	3,06	4,35	5,54	3,21
	Field site K						
37	45,43	4,12	11,01	7,59	6,72	4,45	4,23
38	48,27	3,31	14,56	3,30	8,72	4,00	2,57
39	47,23	3,55	13,29	5,67	5,52	3,44	1,19
40	47,97	3,13	15,32	3,92	6,68	4,24	2,22
	Field site PK						
41	48,23	3,96	12,18	8,53	8,82	4,31	5,45
42	44,57	3,45	12,93	2,35	5,25	4,78	15,38
43	47,94	3,49	13,73	7,74	3,83	4,27	3,70
44	48,68	3,02	16,10	2,72	4,32	6,97	4,33
	Field site NPK						
45	46,03	4,11	11,21	16,87	12,98	3,98	2,10
46	50,63	3,47	14,57	3,73	6,41	4,60	4,47
47	49,46	2,86	17,29	18,26	4,60	3,60	14,08
48	49,36	3,65	12,69	3,53	7,75	4,36	2,23
	Forest site O						
49	43,43	3,79	11,46	12,46	8,73	3,28	4,06
50	48,27	3,46	13,93	4,05	6,52	4,46	1,20
51	46,79	3,04	15,38	4,14	4,56	3,98	3,64
52	46,63	3,17	14,72	6,58	3,71	4,04	9,06

The soils analyzed contained from 43,13 to 52·28% of total carbon and from 1.92 to 4.43% of total nitrogen. Upper layers were richer in total nitrogen than deeper ones. The C/N ratio in soils ranged from about 1 :10 in upper layers to about 1:22 in deeper ones, mostly from 1 : 11 to 1 : 15.

Mineralization of carbon and nitrogen in soils. Changes in peat soil organic matter connected with its agricultural utilization exerted a distinct influence on organic matter mineralization.

The 20-week soil incubation (at 32°C) revealed differences in both mineralization of carbon and organically bound nitrogen.

Fig. 2 showed that the sum of CO_2 secreted from the soil samples after 20 weeks depended on such factors, as the soil profile depth and both cultivation and fertilization treatments. The greatest secretion of carbon dioxide occurred from soil samples taken from the first layer (5—10 cm),

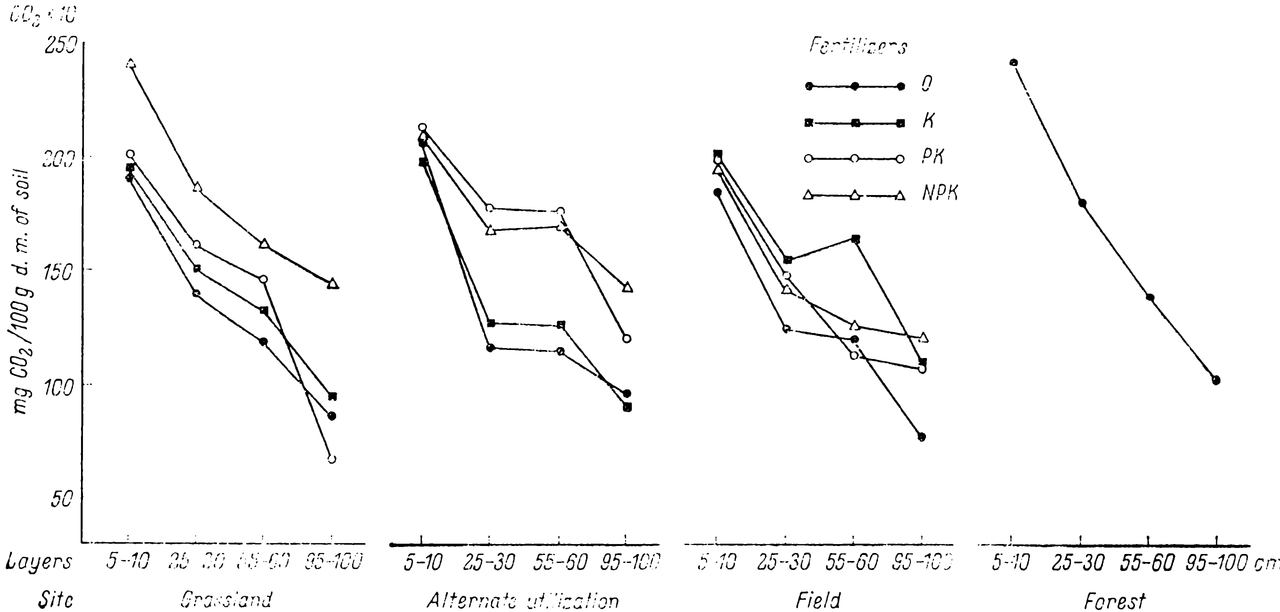

Fig. 2. Total CO_2 evolued during 20 weeks of the soil incubation at 32°C

whereas the CO_2 gradually decreased in samples taken from deper soil layers.

The above differences in the carbon dioxide secretion are affected also by the cultivation and fertilization system. The effect is likely due to the lower or higher accumulation of plant residues as a result of cropping. Considering only the first layer of the soil profile, it can be stated that the most intensive mineralization of peat soil organic matter occurs in the surface layers of NPK-fertilized soils under grassland and forest sites. The sum of the secreted CO_2 in both soils during 20 weeks of their incubation reached 2400 mg CO_2 per 100 g of dry matter. In upper layers of the other soils the CO_2 secretion observed reached 2000 mg CO_2/100 g of dry matter of soil. An insignificant increase of CO_2 secretion to about 2100 mg was also noted in soils under alternate utilization fertilized with PK and NPK or unfertilized.

An increase of the CO_2 secretion from samples taken from upper layers are usually accompanied by an increase of mineralization rate of organic matter in deeper soil profile layers.

As presented in Fig. 3, the average content of CO_2 in soil profiles is the highest in soils fertilized with NPK under the grassland of forest si-

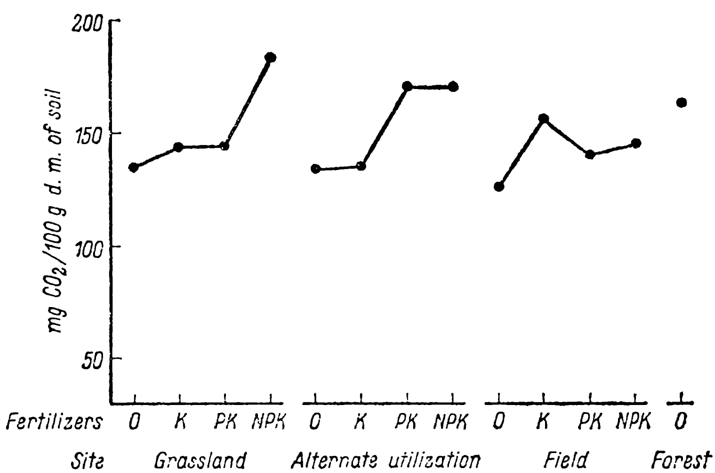

Fig. 3. Average content of CO_2 during the soil incubation at 32°C

tes. The lowest secretion of CO_2 occurs from unfertilized soils of the field, alternate and grassland utilization sites.

The mineralization of organically bound nitrogen was investigated by determining both ammonium and nitrate nitrogen within the 20-week period.

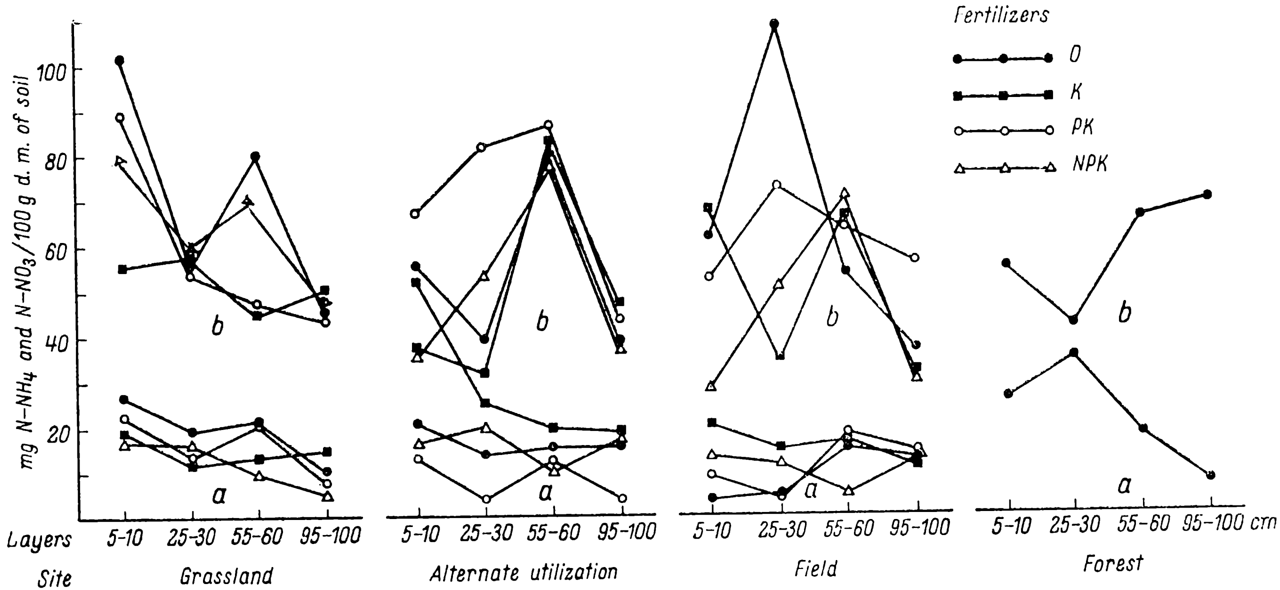

Fig. 4. Total mineral nitrogen *a* — N—NH_4, *b* — N—NO_3 during 20 weeks of the soil incubation at 32°C

Fig. 4 shows that the ammonium nitrogen content in most soils investigates is similar and varies within about 5 mg/100 g of dry matter of soil.

The influence of the soil profile depth as well as the cultivation system on the ammonium content was weak. This is contrary to the nitrate nitrogen (N—NO_3), whose amounts in the soils in vestigated were high after 20 weeks of incubation. Some samples contained nitrate nitrogen levels of over 100 mg/100 of dry matter of soil. Accumulation of nitrates the highest in soil samples taken from the upper layers of PK-fertilized or unfertilized grassland soils. Considerable differences in nitrifaction processses were also observed in samples taken from different horizons, such as second, third or fourth horizon of the soil profile.

An intensive mineralization of organically bound nitrogen was found in all soils investigated (Fig. 5). However, the highest average content of

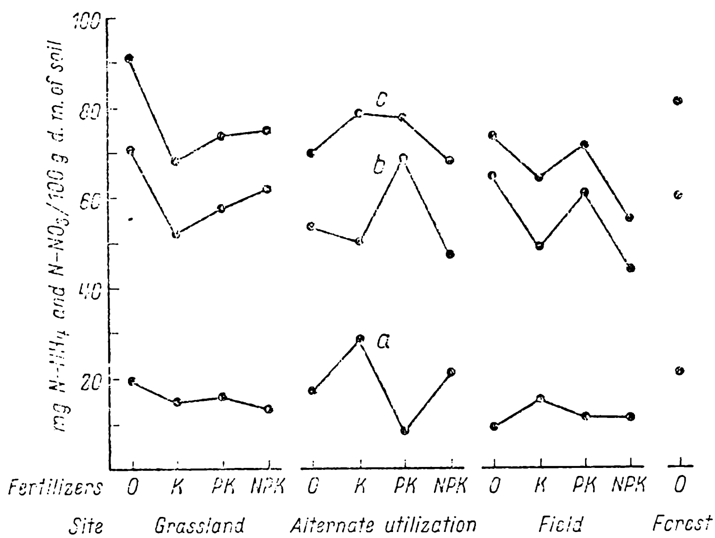

Fig. 5. Average content of mineral nitrogen *a* — N—NH_4, *b* — N—NO_3, *c* — sum (N—NH_4+N—NO_3) in soil profiles during 20 weeks of the soil incubation at 32°C

mineral nitrogen (after 20 weeks) was visible in unfertilized grassland, field and forest soils. A high mineral nitrogen level was found also in PK and NPK fertilized soils under altermate utilization .

DISCUSSION OF RESULTS

The transformation of peat soils in consequence of the agricultural utilization exerts a strong effect on the humification and mineralization process of the soil organic matter. Various agricultural methods of soil cultivation lead to different changes in the soil organic matter [9, 10], increase or decrease of various soil components contained previously in the peat-forming plants. Also distinct synthesis of new compounds due to the action of microorganisms can be expected [1, 4, 10].

Beside the transformation process of peat soil organic matter an intensive mineralization of organically bound carbon and nitrogen occurs as well [3, 4, 9, 10, 13]. However, the mineralization of peat soil depends on its transformation degree, climatic conditions and the utilization system [1, 4, 9]. In some soils the transformation and humification of soil organic matter as well as their mineralization rate were very different. It seems that one the reasons of the difference may be related to the organic matter humification rate, connected with the carbon/nitrogen ratio [4]. However, these factors are affected by the different accumulation of „new humus" in soil during its utilization.

The investigations have proved that the soil organic matter serves as an energy and nutrient source for the soil microflora. Under conditions of a high C/N ratio during the complete decomposition process, most organic carbon is volatilized as CO_2 and only its minor part is assimilated and incorporated into microbial bodies. On the other hand, nitrogen and other nutrients are bound and accumulated there not being exposed to high losses [7, 11]. Consequently, the decomposition process of peat soil organic matter leads invitably to a decrease of readily decomposable material, such as carbohydrates and some proteins and to the concentration of ash, lignin and humus substances [3, 4, 10]. After a certain period, the mineralization and immobilization by microflora will be balanced, where upon nitrogen will become available to plants [4, 5, 13]. The use of some agricultural methods can accelerate or retard the peat soil organic matter decomposition [6, 9, 11]. According to some [6, 14, 15], the new soil humus often decomposes at a faster rate than older humus. Undoubtedly the effect will depend on the amount of „new humus" accumulation in peat soils and also on how deep in the soil it is accumulated.

In the present study the transformation of some soils as well as the decomposition process of their organic matter were different. The mineralization of organic matter, as measured by the CO_2 secretion was very intensive in the samples taken from the surface layers of all soil profiles. The mineralization rate was the highest in the NPK-fertilized soils in the grassland utilization as well as in soil under forest. Intensive mineralization of organic carbon and nitrogen also took place in samples taken from deeper soil profile layers down to 100 cm. This indicates a notable formation of „new humus" from plant residues in deeper layers. The use of mineral fertilizers increased the addition of „new humus", and so increased the mineralization of carbon in the soil profiles considered. However, several questions still remain concerning mineralization of nitrogen, whose total content (after 20 weeks of the soil incubation) was the lowest in the samples taken from plots fertilized with NPK and the highest in samples taken from unfertilized soils in the grassland and forest utilization. As mentioned already, unfertilized soils show a characteristic very low C/N ration. Presumably this effect is caused by carrying away nitrogen with higher yields obtained on fertilized soils.

The fertilization of grassland and field sites led to a decrease of the mineral nitrogen content in soils. However, in soils under alternate utilization sites, fertilized with K and PK, increased the mineralization of organic nitrogen.

The observed ratios between some factors of soil properties in the decomposition process showed some relationships (Table 2). In surface layers of the soils egsamined a high ratio of hemicellulose to cellulose has been noted.

This ratio decreased down profile depending on the soil cultivation method. In particular, the ratio of hemicellulose to cellulose is high in unfertilized soils utilized as grasslands, alternate field-grassland and forest. The higher ratio of hemicellulose to cellulose was also noted in some deeper layers of soil profiles, particularly under field and alternate utilization. However, the deeper layers of soils in the grassland and some in the alternate utilization are usually characterized by low hemicellulose/ /cellulose ratios. This is due to the quicker decomposition rate of hemicellulose than cellulose [4, 11].

The CO_2/N mineral ratio in the decomposition process of peat soils is approximately 5—7. Higher ratio of CO_2 to N_{min} was noticed in surface layers, particularly of the NPK-fertilized soils in the field or alternate utilization.

The ratio of the content of total carbohydrates to the sum of CO_2 secreted within 20 weeks of the soil incubation, amounted to 4—5. The low ratio of carbohydrates to CO_2 secreted was due to decreasing amounts of hemicellulose in lower soil horizons. The ratio of nitrate N to ammonium N in soils can constitute an index of their agricultural efficiency. The higher the $N—NO_3/N—NH_4$ ratio in soil is usually an index of good aerial conditions and of an intensive nitrification process. The soils investigated were rich in nitrate nitrogen, the $N—NO_3/N—NH_4$ ratio being higher in surface than in deeper layers.

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Ф. МАЦЯК, Х. СЁХТИГ

ВЗАИМОСВЯЗЬ МЕЖДУ ПРЕОБРАЗОВАНИЕМ ОРГАНИЧЕСКИХ КОМПОНЕНТОВ, ВЫДЕЛЕНИЕМ ДВУОКИСИ УГЛЕРОДА И МИНЕРАЛИЗАЦИЕЙ АЗОТА В ТОРФЯНЫХ ПОЧВАХ

Кафедра рекультивации и охраны природной среды Варшавской сельскохозяйственной академии
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Резюме

Проводились лабораторные исследования с целью определения влияния продолжительности периода и разных систем сельскохозяйственного использования на интенсивность минерализации торфяных почв.

Почвенные образцы отбирали из торфяных почв используемых в течение 25 в качестве лугов, переменных уголий и пашни. Сверх того анализировали почвенную среду используемую в течение 80 лет в качестве лесного уголья (образцы доставлялись опытной станцией Бебжа).

Виды торфов и содержание в них гуминовых кислот, золы, органического вещества, углерода и общего азота, целлюлозы и геммицеллюлозы определяли совместно с анализом выделенного CO_2 (во время инкубации торфов), а также минерализации азота.

Результаты химического анализа торфов отобранных из разных почвенных сред показали, что система сельскохозяйственного использования торфяных почв оказывала заметное влияние на содержание указанных элементов в почве, а также на интенсивность процесса минерализации углерода и азота.

Влияние сельскохозяйственного использования наблюдалось особенно четко в органических фракциях почвы.

Система возделывания растений сказывала особенно сильное влияние на поверхностные слои профиля. Минерализация углерода в почве происходила с высшей интенсивностью на удобряемых культурах. Минеральное, а особенно азотное удобрение приводило к повышению выделения CO_2, одновременно снижая минерализацию азота в торфяных почвах.

F. MACIAK, H. SÖCHTIG

WSPÓŁZALEŻNOŚĆ MIĘDZY PRZEKSZTAŁCANIEM SIĘ SKŁADNIKÓW ORGANICZNYCH A WYDZIELANIEM DWUTLENKU WĘGLA I MINERALIZACJĄ AZOTU W GLEBACH TORFOWYCH

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Streszczenie

Przeprowadzono laboratoryjne doświadczenia w celu zbadania wpływu długości okresu i różnego systemu użytkowania rolniczego na intensywność mineralizacji gleb torfowych.

Próbki glebowe pobrano z siedlisk gleb torfowych użytkowanych przez 25 lat jako łąki przemiennie oraz pola uprawne. Ponadto analizowano siedlisko glebowe będące przez około 80 lat w użytkowaniu leśnym. Próbki pochodziły z Zakładu Doświadczalnego Biebrza.

Gatunki torfów oraz zawartość w nich kwasów huminowych, popiołu, materii organicznej, węgla i azotu ogółem, celulozy i hemicelulozy rozpatrywano łącznie z analizą wydzielającego się CO_2 (w czasie inkubacji torfów) i mineralizacją azotu.

Wyniki chemicznej analizy torfów pobranych z różnych siedlisk wykazały, że system rolniczego użytkowania gleb torfowych ma wyraźny wpływ na zawartość w nich omawianych składników w glebie oraz na intensywność w nich mineralizacji węgla i azotu.

Jednak wpływ użytkowania rolniczego okazał się widoczny szczególnie w organicznych frakcjach gleby.

Systemy upraw rolniczych miały szczególny wpływ na wierzchnie warstwy gleby torfowej, lecz wpływ ten widoczny był również w głębszych warstwach profilów glebowych. Mineralizacja węgla w glebie odbywała się intensywniej na kombinacjach nawożonych. Nawożenie mineralne, a szczególnie nawożenie azotowe zwiększało wydzielanie się CO_2, natomiast przeważnie zmniejszało mineralizację azotu w omawianych glebach torfowych.

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