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THE EFFECT OF MELIORATION PLOUGHING AND PLANT COVER ON THE ORGANIC MATTER OF LIGHT SOILS

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Relatively large areas of Europe including Poland particularly those glaciated in the Pleistocen are covered by soils formed from sands. These soils are usually non-fertile. Therefore an important task for agriculture is their reclamation to increase of crops. One of the reclamation means is melioration ploughing with the use of various materials to change the make-up of the soil profile [9].

Among numerous papers on melioration of sandy soils [1, 3, 5, 6, 8, 12] only few of them deal with the effects of the above opperation on the organic matter in these soils [3, 6, 8].

METHODS AND SOIL CHARACTERISTICS

Soil samples were taken from experimental plots at the Uhrusk Agricultural Experimental Station of the School of Agriculture in Lublin. This station is in East Poland and its ecological conditions are characteristic for the Large East European Lowland. The soils examined belong to the pseudopodzolic ones formed from fluvioglacial sands [4]. Their texture is as follows:

Depth in cm	Partic. Ø 1—0,1 mm	0,1—0,01	< 0,01
	%	%	%
0—25	85	9	6
30—50	89	7	4
60—70	87	10	3

The data of chemical properties are given in table 1. The field in whith experiments vere caried out was with the following crop succession:

1962 — potatoes manured,
1963 — maize for green forage,
1964 — lupin,
1965 — Sheep's fescue (*Festuca ovina*) with Lady's fingers (*Antylis vulneraria*),
1966 — rye.

Table 1

Some properties of soils investigated

Sample No.	Depth cm	Total C	Total N	C:N	pH in 1N KCl	Aveilable m.e. / 100 g soils	
						P_2O_5	K_2O
1	5-15	0.588	0.14	4.2	6.0	11.0	4.6
2	5-15	0.546	0.10	5.5	6.3	11.9	9.9
	40-45	0.559	0.13	4.3	6.7	8.4	5.1
3	5-15	0.557	0.13	4.3	6.1	6.7	5.2
	40-45	0.780	0.11	7.7	6.6	13.8	8.8
4	5-15	0.519	0.13	4.0	6.1	13.8	8.4
5	5-15	0.529	0.14	3.8	6.2	10.6	5.4

Soil samples vere taken in autumn 1966 from experimentale plots with folloving combinations:

1. Ploughing at 25 cm without melioration manuring, full fertilizing (NPK).
2. Melioration ploughing — 500 q of manure ploughed down at 45 cm in autum 1961, full fertilizing (NPK).
3. Melioration ploughing — peet ploughed down at 45 cm in autum 1961, full fertilizing.

Extra samples were taken:

4. From bare fallow since 1962. Surface ploughing to controle weeds, without fertilizing.
5. From field with sheep's fescue; full fertilizing.

The composition analysis of organic compounds was done with Boratyński and Wilk method [2]. Optical density of humic acids was determined by the method described by Kononowa [7]. The content of organic C and N, pH, available P_2O_5 and K_2O were estimeted with known and generally used methods.

RESULTS

The data of the organic matter analysis are shown in Tab. 2 and Fig. 1. They point to effective influence of melioration ploughing on the composition of organic compounds in light soils. It becomes distinct in the increase of humic acids content especially, what in consequence results in broder relation of Ch:Cf in soils with melioration ploughing. In those soils there can also be noticed on increase of humin and ulmin content what undoubtedly leads to improvement of physical properties of there soils. On exceptionaly large amount of humins and ulmins is in the layer at the depth of 40—45 cm in the soil being meliorating with peat at this depth.

Table 2

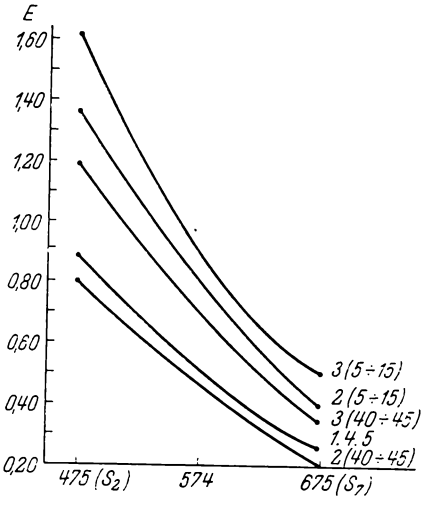
Composition of organic matter of soils investigated

Sample No.	Depth cm	Bitumins in total C %	Soluble compounds in $Na_4P_2O_7$ of total C - %			Ch:Cf	Soluble compounds in NaOH of total C - %			Ch:Cf	Humins and ulmins
			total amount	humic acids Ch	fulvic acids Cf		total amount	humic acids Ch	fulvic acids Cf		
1	5-15	7.7	12.2	5.1	7.1	0.72	23.5	11.1	12.4	0.90	56.6
2	5-15	7.7	11.0	5.1	5.9	0.88	12.6	7.1	5.5	1.30	68.7
	40-45	9.8	14.3	6.8	7.5	0.91	22.0	12.2	9.8	1.24	53.9
3	5-15	7.7	11.8	6.1	5.7	1.06	18.3	11.1	7.2	1.55	62.2
	40-45	3.2	9.2	5.0	4.2	1.18	10.0	5.8	4.2	1.37	77.6
4	5-15	7.5	18.5	7.5	11.0	0.68	25.4	12.0	13.4	0.90	48.6
5	5-15	9.2	11.3	5.1	6.2	0.82	22.7	10.6	12.1	0.88	56.8

It seams to be brought about by introducing a large amount of "humic coal" together with peat; such a distinct stabilization of humic compounds in the form of organo-mineral complexes is not likely to occur in soils of such a "light" texture.

A small amount of soluble in weak solvents substances prooves the presence of a great quantity of "humic organic coal" and other substances undergoing slow decomposition. They microbiological decomposition is slower then in other soils investigated because of the broadest relation of C:N and because of a small content of simple organic compounds.

It is, however, interesting that though slow yet successive humification process leads above all to the formation of humic acids.



Extinction curves of humic es acids of soils examinated

However the introduced melioration manure doses decompose much quicker than peat. This is favoured by greater participation of the introduced matter of organic compounds which easily undergo microbiological restoration. In a deeper layer (40—50 cm), however in relation to the surface on this process is slower what facilitates the following manure action and it obviously inhibits possible losses which may occur in light soil during a rapid decomposition of the organic matter.

The delay of the decomposition process can be seen distinctly by the increased amount of fresh humic compounds (pyrophosphate fraction) still after 5 years in the deeper layer and by a generally considerable amount of soluble forms in that horizon, whereas in upper horizons no distinct differences in relation to typical cultivation are observed. It is worth noticing that like in the meliorated soil with peat there can be found an increase of humic acids content with the use of manure what can be taken as the factor of improved farming [3].

Less significant though distinct differences were found in the composition of organic compounds by typical cultivation but under various plant cover. A distinct increase of mobile humic compounds, soluble in pyrophosphates, can be noticed in a sample of bare fallow. The organic compounds in that sample possess a more mobile character, and humus acids are represented by the contained quantity of fulvic acids the relation of which to humic acids is the broadest of all soils investigated. Due to the lack of fresh organic matter supply for that soil it appears that the decomposition of the proper humic compounds by the soil "edafon" is likely to start what must result with determined succession in depolymeriza-

tion and decondensation of acids and in the occurrence of a more considerable amount of humine acids with a small aromatic nucleus (fulvic acids).

The improvement of conditions for the formation of a greater amount of humic acids, though not so distinct as by melioration ploughing, can be observed under the cover of sheep's fescue. This is confirmed by the data obtained and by those from other soils on the influence of some many years old plant covers [10, 11] on the composition of humic compounds. Under grass cover this takes place mainly due to the permanent lack of oxydation because of this field being not cultivated for many years and because of a relatively steady supply of a fresh organic matter.

From the extinction curves there can be observed an advantageous influence of melioration ploughing not only on the increase of humic acids amount but also on the condensation degree of their aromatic nucleus.

Aromatic nuclei of humic acids in the upper layers of soils with melioration ploughing with the use of manure and peat are bigger than those of acids selected from other soils. The smallest nuclei occur in humic acids from the melioration layer of manure. This would support earlier statements and still active restoration processes of organic matter in the polimerization and condensation stages of nuclei of new-formed humic acids.

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L'INFLUENCE D'UNE CULTURE D'AMENDEMENT ET DE LA COUVERTURE VÉGÉTALE SUR LA SUBSTANCE ORGANIQUE DES SOLS LÉGERS

Chaire de Pédologie de la Haute École d'Agriculture a Lublin

Résumé

On a prélevé à la ferme expérimentale de Uhrusk appartenant à la Haute Ecole d'Agriculture de Lublin, des échantillons du sol des champs d'expérience cinq ans après une culture d'amendement avec application du fumier et de la tourbe, comme substance introduite à 45 cm de profondeur dans le profil d'un sol sabloneux. A fine comparatives on préléva aussi des échantillons d'un champ cultivé et fumé d'une façon identique, mais non amendé en profondeur ainsi que d'un champ en friche et d'un champ engazonné par la fétuque ovine.

On analyse par la méthode de Boratyński et de Wilk la composition de la substance organique dans les échantillons prélévés et on détermina la densité optique des acides humiques séparés.

En se basant sur les données obtenues on peut tirer des conclusions suivantes:

1. Une culture d'amendement tant avec l'application du fumier que de la tourbe, a eu une influence positive sur la quantité de la substance organique, par rapport à une culture traditionnelle.

a. la quantité des acides humiques augmentaet leur rapport aux acides fulviques diminua,

b. les acides humiques se distinguaient par une plus grande condensation du noyau aromatique, surtout les acides humiques des niveaux de surface.

2. La dynamique de décomposition de la substance organique introduite en profondeur du profil du sol est retardée par rapport à celle des niveaux de surface, ce qui favorise son action successive plus longue. Les combinaisons humiques formées de cette décomposition se distinguent par une prépondérance des acides humiques sur les acides fulviques.

3. Parmi les façons d'usage du sol l'influence la plus favorable sur les combinaisons humiques avait — un engazonnement permanent, la moins favorable — les sols en friche.

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EINFLUSS DER MELIORATIVEN BEARBEITUNGSMASSNAHMEN UND DER PFLANZENDECKEARTEN AUF DEN ORGANISCHEN STOFF LEICHTER BÖDEN

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Zusammenfassung

Im Versuchsgut Uhrusk der Landwirtschaftlichen Hochschule in Lublin wurden von den Versuchsparzellen, nach fünfjähriger meliorativen Bearbeitung derselben unter Einbringung des Stallmists und des Torfes auf die Tiefe von 45 cm in den Sandbodenprofil, die Bodenproben entnommen. Zwecks Vergleich wurden auch die Bodenproben von einer identisch bearbeiteten und gedüngten Parzelle, aber ohne Untergrundmelioration, sowie von einer Schwarzbrache und einer mit Schafschwingel bewachsene Fläche entnommen.

In den angesammelten Proben wurde nach der Methode von Boratyński und Wilk die Zusammensetzung des organischen Stoffes analysiert und die optische Dichte der abgesonderten Huminsäuren bestimmt.

Auf Grund der erhaltenen Daten können folgende Schlüsse gezogen werden:

1. Die meliorative Bearbeitung, sowohl mit Stallmist- als auch Torfeinbringung, übte einen günstigeren Einfluss auf die Qualität des organischen Stoffes, im Vergleich zur traditionellen Bearbeitung, und zwar:

— es erhöhte sich Huminsäurengehalt bei einer Verengung des Verhältnisses zwischen denselben und den Fulvosäuren;

— es trat eine höhere Kondensation des aromatischen Kernes der Huminsäuren, insbesondere dieser aus den oberflächlichen Horizonten.

2. Die Abbaudynamik der in die Bodenprofiltiefe eingebrachten organischen Stoffe ist im Verhältnis zu oberen Horizonten verspätet, was zur Verlängerung der Nachwirkung derselben beiträgt. Die sich davon bildenden Humusverbindungen zeichnen sich mit einem Übergewicht von Huminsäuren über Fulvosäuren in denselben aus.

3. Unter den Nutzungsarten wirkt auf die Humusverbindungen die Dauerberasung am günstigsten, die Schwarzbrache — weniger günstig, auf.

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WPŁYW MELIORACYJNEJ UPRAWY I POKRYW ROŚLINNYCH NA SUBSTANCJĘ ORGANICZNĄ GLEB LEKKICH

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Streszczenie

W gospodarstwie doświadczalnym Uhrusk WSR w Lublinie pobrano próbki z poletek doświadczalnych w pięć lat po uprawie melioracyjnej z zastosowaniem obornika i torfu jako substancji wnoszonej na głębokość 45 cm w profil gleby piaszczystej. Dla porównania wzięto próbki z poletka identycznie powierzchniowo uprawianego i nawożonego, lecz nie meliorowanego wgłębnie, oraz z czarnego ugoru i pola zadarnionego kostrzewą owczą.

W zebranych próbkach przeprowadzono metodą Boratyńskiego i Wilka analizę składu substancji organicznej oraz oznaczono gęstość optyczną wyodrębnionych kwasów huminowych.

Na podstawie zebranych danych dadzą się wyprowadzić następujące wnioski:

1. Uprawa melioracyjna zarówno z zastosowaniem obornika, jak i torfu wpłynęła korzystnie na jakość substancji organicznej w stosunku do uprawy tradycyjnej:

— nastąpiło zwiększenie ilości kwasów huminowych i zwężenie ich stosunku do fulwokwasów,

— kwasy huminowe odznaczały się większą kondensacją jądra aromatycznego, szczególnie kwasy huminowe z poziomów powierzchniowych.

2. Dynamika rozkładu substancji organicznej, wniesionej w głąb profilu glebowego, jest opóźniona w stosunku do poziomów wierzchnich, co sprzyja jej dłuższemu następczemu oddziaływaniu. Tworzące się z niej związki próchniczne odznaczają się przewagą kwasów huminowych nad fulwokwasami.

3. Ze sposobu użytkowania najbardziej korzystnie oddziaływało na związki próchniczne trwałe zadarnienie, najmniej czarny ugór.

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ВЛИЯНИЕ МЕЛИОРИРУЮЩЕЙ ВСПАШКИ И РАСТИТЕЛЬНОГО ПОКРОВА НА ОРГАНИЧЕСКОЕ ВЕЩЕСТВО ЛЕГКИХ ПОЧВ

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Резюме

На опытном хозяйстве Угруск ВСШ в Люблине были взяты образцы почв с делянок пять лет спустя после выполнения мелиорирующей вспашки с применением навоза и торфа, вносимых в песчаную почву на глубину 45 см. Для сравнения были отобраны образцы с аналогично обрабатываемой и удобряемой делянки, но без мелиорирующей вспашки, а также с поля находящегося под черным паром и под покровом овсяницы овечьей.

В отобранных образцах определяли состав органического вещества по методу Боратыньского и Вилька и обозначали оптическую плотность гуминовых кислот.

На основании полученных данных могут быть сделаны следующие выводы:

1. Мелиорирующая вспашка так с применением навоза, как и торфа, положительно повлияла на качество органического вещества, по сравнении с обыкновенной (традиционной) вспашкой:

— последовало увеличение количества гуминовых кислот и затеснение их соотношения к фульво-кислотам

— гуминовые кислоты отличались большей конденсированностью ароматического ядра, особенно гуминовые кислоты из поверхностных горизонтов.

2. Динамика разложения органического вещества вносимого глубже в почвенный профиль протекает медленнее, по сравнении с внесением в верхние горизонты, что способствует более длительному его последействию. Образующиеся из него гумусовые соединения отличаются преобладанием гуминовых кислот над фульвокислотами.

3. Из способов пользования наиболее положительно на гумусовые соединения действовала многолетняя дернина, наименее положительно — черный пар.