

THE INFLUENCE OF FERTILIZING WITH MANURE ON THE SOIL ACIDITY

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Abstract. The research was carried out in a multiannual field experiment initiated in 1977 in ZD IUNG in Baborówko on loamy soil included to a good wheat complex. In a four-year cycle of crop rotation mineral fertilization (NPK) and organic (swine slurry) were applied. The dosage of mineral fertilizer was adjusted to the nutrition demand of the plants. Manure was applied in doses balancing the amount of nitrogen in the mineral fertilizers and doubled doses. Samples of soil taken after the harvest of plants cultivated in the last link of the crop succession's third rotation.

Long-term fertilization with liquid manure did not influence the reaction in the arable layer of the soil. In the sub-arable layer the soil acidity increased from neutral reaction on the NPK object to slightly acid on that fertilized with liquid manure of both dosages. Fertilizing with liquid manure in doubled dosage influenced an increase in the hydrolytic acidity, decrease in the contribution of exchange of calcium and decrease in the degree of the sorption complex saturation with base cations.

Generally, content of C in the compared objects was similar. Under the influence of liquid manure fertilizing followed an increase of participation of labile humus compounds fractions and a decrease carbon compounds containing humine acids bound with calcium.

Key words: liquid manure, soil acidity, NPK fertilization

INTRODUCTION

One of the directions of research about the results of fertilizing is the evaluation of content and availability of nutritive elements for plants. Fertilizing plays an extremely important role in the shaping of reaction and participation of hydrogen ions in the sorption complex of the soil.

In literature there appear often contradictive opinions about the behaviour of mineral elements, degree of acidification and soil organic metabolism under the influence of differentiated mineral and organic fertilizing [1,3,4,6]. The range of these changes is also influenced by different soil conditions, as well as fertilizer dosages, applied to cultivated plants in crop succession.

The aim of this work was to determine the influence of multiannual fertilizing with liquid manure on the acidity and the quantitative and qualitative content of organic matter in loamy soil.

MATERIALS

The research was carried out in a multiannual field experiment initiated in 1977 in ZD IUNG in Baborówko. The experiment was carried out on loam soil included to land-capability class III b, of good wheat complex. In a four-year cycle of crop succession mineral fertilization (PK, NPK) and organic (pig liquid manure) were applied. The dosage of mineral fertilizer was adjusted to the nutrition demand of the plants. Manure was applied in such doses that the contribution of liquid manure nitrogen in an optimum dose of the element for the cultivated plant (% N in NPK) amounted to 50, 75, 100, 150, and 200 %.

The research was carried out only on selected objects of experiment, to which liquid manure was applied in dosages of 100 and 200 % of nitrogen applied to plants in mineral fertilizers, and to NPK object. Samples of soil were taken after the harvest of plant cultivated in the last link of the crop succession third rotation. The soil physicochemical properties were determined, with the help of methods broadly used in soil science. The fraction content of humus compounds was determined according to Turin method.

RESULTS

The results presented in Table 1 show that a long-term fertilizing with pigs' liquid manure does not influence changes in the reaction of arable layer of loam soil. The reaction of the compared experiment objects was slightly acid, and the reaction of the object fertilized with liquid manure in doubled doses (200 % of N) pH values were lower than of the control object (range 5.7-6.4 pH). In the sub-arable layer the soil acidity increased from a neutral reaction on the control object fertilized exclusively with NPK, to slightly acid on objects fertilized with liquid manure in both dosages.

Changes occurring in the soil reaction correlated with shaping of the hydrolytic acidity on the compared subjects of experiment. Fertilizing with liquid manure, especially in doubled doses caused an increase in the hydrolytic acidity and was a result of a decrease of exchange calcium participation in the soil sorption complex in the arable and sub-arable layers. It was expressed by a visible decrease in the degree of

the sorption complex saturation with base cations in a soil fertilized with liquid manure for a long time, at doubled doses of nitrogen.

Similar changes were described also by other authors [1,3,6]. Results confirming the alkaline influence of liquid manure on soil can also be found in literature [5]. It proves the complexity of factors influencing the acidity of a soil.

On the basis of research and the results presented in Table 2 it was determined that the content of organic material in the compared objects of experiment shaped on a similar level (0.81-0.86 % of C total in the arable-humus horizon and 0.62-0.67 % generally in the sub-arable layer). Certain changes were found in the fraction composition of humus compounds. They were especially visible in the free fraction separated from soil using 0.1 mol NaOH dm⁻³.

Under the influence of a long-term fertilizing with pigs' liquid manure the amount of carbon isolated in this fraction increased from 22.84 % on the NPK object to 29.53 % on the object fertilized with doubled doses of liquid manure.

A reflection of the humification processes taking place in soil under the influence of liquid manure fertilizing were the changes occurring in the carbon compounds of humine acids bound with calcium. In the objects fertilized with liquid manure a decrease in content of these linkages was observed, in the arable as well as in the sub-arable layer. It proves an increase in the mobility of humus compounds in soil under the influence of a long-term application of liquid manure, which was also pointed out by Koc [2].

The described changes in the fraction content of humus clearly correspond with the

Table 1. Influence of liquid manure on some properties of soil

Liquid manure rate % of N in NPK	pH (mol KCl dm ⁻³)	Hh			V (%)	Ca ²⁺ (%)
		(mmol+)/100 g of soil				
		5-20 cm				
NPK	6.4	0.82	9.41	92.0	80.8	
100	6.4	0.82	9.22	91.8	77.3	
200	5.7	1.31	7.92	85.8	68.8	
		30-40 cm				
NPK	6.6	0.52	9.52	94.8	83.1	
100	6.3	0.60	8.73	93.6	75.0	
200	5.8	1.12	7.50	87.0	73.7	

Table 2. Influence of liquid manure on fractional composition of humus compounds

Liquid manure rate % of N in NPK	C total (%)	0.5 mol H ₂ SO ₄ dm ⁻³ (I fraction)		0.1 mol NaOH dm ⁻³ (II fraction)			0.1 mol NaOH dm ⁻³ (fraction free)				Ckh bound with Ca	
		C- extracted	C- extracted	Ckh	Ckf	Ckh/Ckf	C- extracted	Ckh	Ckf	Ckh/Ckf		
												% C total
												5-25cm
NPK	0.81	10.00	43.70	22.22	21.48	1.034	22.84	7.90	14.94	0.529	14.32	
100	0.84	10.00	43.93	23.33	20.60	1.133	23.69	10.47	13.22	0.793	13.86	
200	0.86	12.58	47.91	24.42	23.49	1.039	29.53	12.79	16.74	0.764	11.63	
												30-40cm
NPK	0.62	12.57	44.68	21.77	22.91	0.950	22.42	6.87	15.55	0.442	14.90	
100	0.66	11.51	48.48	24.39	24.08	1.012	27.57	10.15	17.42	0.583	14.24	
200	0.67	14.03	45.97	21.19	24.78	0.855	26.57	8.95	17.61	0.508	12.24	

content of exchange calcium in the soil sorption complex, as well as shaping of the hydrolytic acidity in the soil of the compared objects.

CONCLUSIONS

1. Many years' fertilizing with liquid manure caused changes in the composition of the sorption complex, in which the contribution of hydrogen ions increased, and the content of exchangeable calcium decreased.

2. The liquid manure used in research caused an increase in the contribution of labile carbon fractions in the total amount of soil humus.

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WPŁYW NAWOŻENIA GNOJOWICĄ NA ZAKWASZENIE GLEBY

Badania prowadzono w doświadczeniu połowym wieloletnim założonym w 1977 roku w ZD IUNG w Baborówku na glebie gliniastej zaliczanej do kompleksu pszennego dobrego. W czteroletnim cyklu zmianowania stosowano nawożenie mineralne (NPK) i organiczne (gnojowica trzody chlewnej). Wielkość dawek nawozów mineralnych była dostosowana do wymagań pokarmowych roślin. Gnojowicę stosowano w dawce równoważącej ilość azotu w nawozach mineralnych oraz w dawce podwojonej. Analizowano próbki gleby pobrane po zbiorze roślin uprawianych w ostatnim ogniwie trzeciej rotacji zmianowania.

Długotrwałe nawożenie gnojowicą nie wpłynęło na zmianę odczynu w warstwie omejej gleby. W warstwie podomejej zakwaszenie gleby zwiększało się od odczynu obojętnego na obiekcie NPK do lekko kwaśnego na obiektach nawożonych gnojowicą w obu dawkach. Nawożenie gnojowicą w dawce podwojonej wpłynęło na wzrost kwasowości hydrolytycznej, zmniejszenie udziału wapnia wymiennego oraz spadek stopnia wysycenia kompleksu sorpcyjnego gleby kationami zasadowymi. Zawartość C ogółem na porównywanych obiektach była podobna. Pod wpływem nawożenia gnojowicą nastąpił wzrost zawartości labilnych frakcji związków próchnicznych oraz spadek połączeń węgla kwasów huminowych związanych z wapniem.

Słowa kluczowe: kwasowość gleby, gnojowica, nawożenie NPK.