THE INFLUENCE OF RESIDUAL ORGANIC FERTILIZATION UPON WINTER WHEAT GRAIN YIELD AND SOME SOIL CHEMICAL PROPERTIES IN THE WINTER WHEAT – MAIZE CROP ROTATION

INFLUENTA FERTILIZĂRII ORGANICE REZIDUALE ASUPRA PRODUCȚIEI GRÂULUI DE TOAMNA SI ASUPRA UNOR PROPRIETĂȚI CHIMICE ALE SOLULUI IN ROTAȚIA GRÂU – PORUMB

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Abstract: *The paper presents the results of three-year investigations of residual organic fertilization for winter wheat in the crop rotation: winter wheat – maize on cambic chernozem from Timisoara. Efficiency of organic residual fertilization with respect to the winter wheat grain yield varied over the three-year research period. Higher yields were obtained with residual organic fertilization compared to control and standard mineral fertilization. Organic residual fertilization leads to an increase of soil pH, total exchange capacity, and degree of base saturation.*

Rezumat: *In lucrare sunt prezentate rezultatele cercetărilor privind efectul rezidual al fertilizării organice, timp de trei ani, asupra grâului de toamna, in rotația grâu – porumb, pe cernoziomul cambic de la Timişoara.. Eficienta fertilizării reziduale organice asupra producției de grâu de toamna a fost variabila pe parcursul celor trei ani de experimentare. Cele mai ridicate producții au fost determinate in variantele cu fertilizare organica reziduala comparativ cu martorul si fertilizarea minerala standard. Fertilizarea organica reziduala a dus la creşterea valorilor pH-ului, a capacității totale de schimb cationic si a gradului de saturație in baze.*

Key words*: organic fertilization, soil chemical properties, wheat grain yield*
Cuvinte cheie*: fertilizare organica, proprietățile chimice ale solului*

INTRODUCTION

Researches made on wheat and maize field experiments shows that negative interactions take place when organic and mineral fertilizers are applied together. Yield rise after simultaneous organic and mineral fertilization is lower than sum of yield rises after detached manure and mineral fertilization.

Yield rises after detached manure; mineral fertilization is lower on chernozems, brown, and argyle soils, but higher on soils with various limitations, especially because of manure's complex effect. Thanks to manure nutritive elements content and energetic contribution, its application leads to improvement of some soil unfavourable features.

When manure is applied, it is expected to increase soil nutrient content necessary for crop formation.

Being that organic fertilizers effect are better improved by cultivated crops than uncultivated crops, is recommended to apply organic fertilizers on cultivated crop (maize), within crop rotation. Straw cereals (wheat) take better advantage from organic fertilizers residual effect.

MATERIAL AND METHOD

The organic fertilizers were applied in different doses on maize crop, using manure, sewage sludge, and swine sludge. The experiment is stationary and bi-factorial:

- factor A – annual fertilization cattle manure and swine sludge, in four doses: 0t/ha, 40t/ha, 60t/ha and 80 t/ha
- factor B – annual fertilization with sewage sludge, in four doses: 0t/ha, 40t/ha, 60t/ha and 80 t/ha

In mineral standard fertilization plot were applied 150kg N/ha, 75 kg P_2O_5/ha and 75 kg K_2O/ha. Fertilizer we used was complex 15:15:15 and ammonium nitrate.

Soil pH was determined in water extract 1:2, 5 by pH-meter Metler Delta 340. Soil hydrolytic acidity and total exchange bases was determinate by Kappen method. The degree of base saturation and total exchange cation capacity were determined by calculating, using the two indicators (hydrolytic acidity and total exchange bases). Nitrogen was determined by Kjeldhal method. Phosphorus was extract in ammonium acetate – lactate solution, and his content determined with UV – VIS spectrophotometer Abble – Jasco, at wavelength of 450 nm. Potassium was extract in ammonium acetate – lactate solution, and content determination was made by emission with atomic absorption spectrophotometer Buck-Scientific, at wavelength of 766 nm.

RESULTS AND DISCUSSIONS

As it shown in table 1, highest grain yield was determined after residual fertilisation with cattle manure, 4580 kg/ha. Residual fertilization with sewage sludge lead to lower grain yields, ranged between 2900-3800 kg/ha. In second year of application, availability degrees of plant main macroelements from cattle manure (20% for N, 22% for P_2O_5 and 25% for K_2O) are higher then those from sewage sludge and swine sludge. This means that cattle manure release at plant disposal a larger amount of nutrients for plant formation. As far as the fertilizer dose is concerned, highest grain yield is determined in plots pre-fertilized with 60t/ha cattle manure (4580 kg/ha) and swine sludge (3260 kg/ha), and at plot pre-fertilized with 40 t/ha sewage sludge. Compared with control and standard mineral fertilization plots, residual fertilization with 60 t/ha cattle manure lead to grain yields with 2315 kg/ha, respective with 1940 kg/ha.

Table 1

Influence of residual organic fertilization upon winter wheat grain yield

Variant		Grain yield Kg/ha	Relative yield %	Differences Kg/ha	Signification
Control		2265	100.00	-	-
$N_{150}P_{75}K_{75}$		3640	160.71	1375	***
Swine sludge	40 t/ha	2900	128.04	635	**
	60 t/ha	3260	143.93	995	***
	80 t/ha	3125	137.99	860	***
Cattle manure	40 t/ha	4390	193.82	2125	***
	60 t/ha	4580	202.21	2315	***
	80 t/ha	4510	199.12	2245	***
Sewage sludge	40 t/ha	3550	156.73	1285	***
	60 t/ha	3600	158.94	1335	***
	80 t/ha	3800	167.77	1535	***

DL 5% = 344.2
DL 0.1% = 468.9
DL 0.1%= 630.2

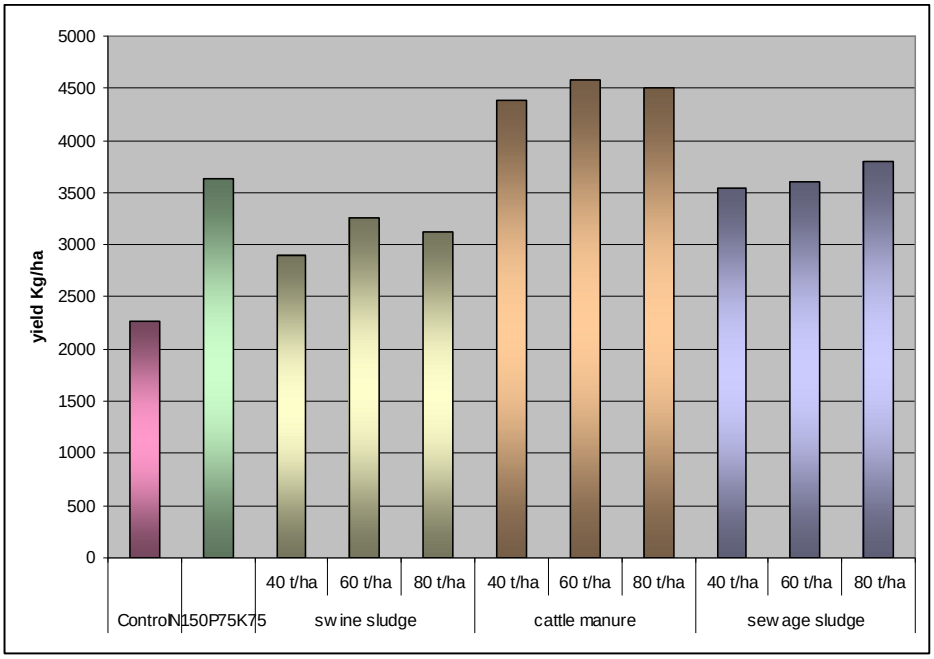

Fig.1 Influence of residual organic fertilization upon winter wheat grain yield

Compared with control and standard mineral fertilization plots, residual fertilization with 60 t/ha cattle manure lead to increased grain yields with 2315 kg/ha, irrespective with 1940 kg/ha.

Some soil chemical properties after residual organic fertilization are presenter in table 2:

Table 2

Influence of residual organic fertilization upon soil pH, total cationic exchange capacity and degree of base saturation

Variant		pH	T me/100g soil	V %
Control		6.18	31.3	81.0
$N_{150}P_{75}K_{75}$		6.06	30.8	81.2
Swine sludge	40 t/ha	6.13	31.6	80.8
	60 t/ha	6.08	30.5	81.3
	80 t/ha	6.05	30.2	80.7
Cattle manure	40 t/ha	6.40	32.5	88.4
	60 t/ha	6.60	33.6	91.0
	80 t/ha	6.75	34.1	94.8
Sewage sludge	40 t/ha	6.20	31.9	87.0
	60 t/ha	6.45	32.2	89.7
	80 t/ha	6.40	32.3	89.3

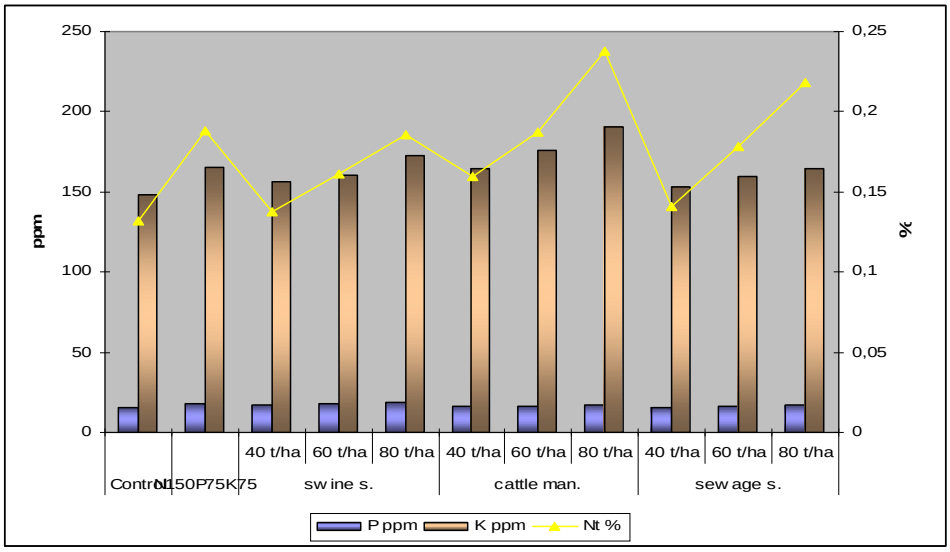

Fig.2. Influence of residual organic fertilization upon soils total nitrogen , phosphorus and potassium content

Residual fertilization with swine sludge lead to decrease of soil pH, from 6.14 in control plot to 6.05 at highest swine sludge dose. Total cationic exchange capacity and degree of base saturation values also decrease as the swine sludge dose rise.

Highest pH, T and V values are determined after residual fertilization with cattle manure. Cattle manure is rich in potassium and has a weak alkaline reaction, so his application on cambic chernozem with weak acid reaction, will lead to increased pH, T and V values.

Table 3

Influence of residual organic fertilization upon soils total nitrogen , phosphorus and potassium content

Variant		Nt %	P ppm	K ppm
Control		0.132	15.1	148.3
$N_{150}P_{75}K_{75}$		0.188	17.9	165.1
Swine sludge	40 t/ha	0.138	16.8	156.3
	60 t/ha	0.161	17.9	160.1
	80 t/ha	0.186	18.6	172.6
Cattle manure	40 t/ha	0.160	15.9	164.5
	60 t/ha	0.187	16.5	175.6
	80 t/ha	0.238	17.2	190.6
Sewage sludge	40 t/ha	0.141	15.6	153.4
	60 t/ha	0.178	16.1	159.4
	80 t/ha	0.218	16.9	164.6

Residual fertilization with sewage sludge determined rise of ph, T, and V values compared to control and standard mineral fertilization. On plots pre-fertilized with 40 t/ha and 60t/ha sewage sludge we determined following values: pH=6.20, T=31.9 me/100g soil, V=87% irrespective pH=6.45, T=32.2 me/100g soil, V=89.7%. pH, T, and V values determined after pre-fertilization with 80t/ha, sewage sludge is comparative with dose obtained on plot pre-fertilized with 60t/ha sewage sludge.

As far as the soil nutrient content is concerned (table 3), after residual organic fertilization we determined increased total nitrogen, phosphorus and potassium soil content compared with control plot. Low doses of organic fertilizers determined only slight increase of soil nitrogen, phosphorus, and potassium content.

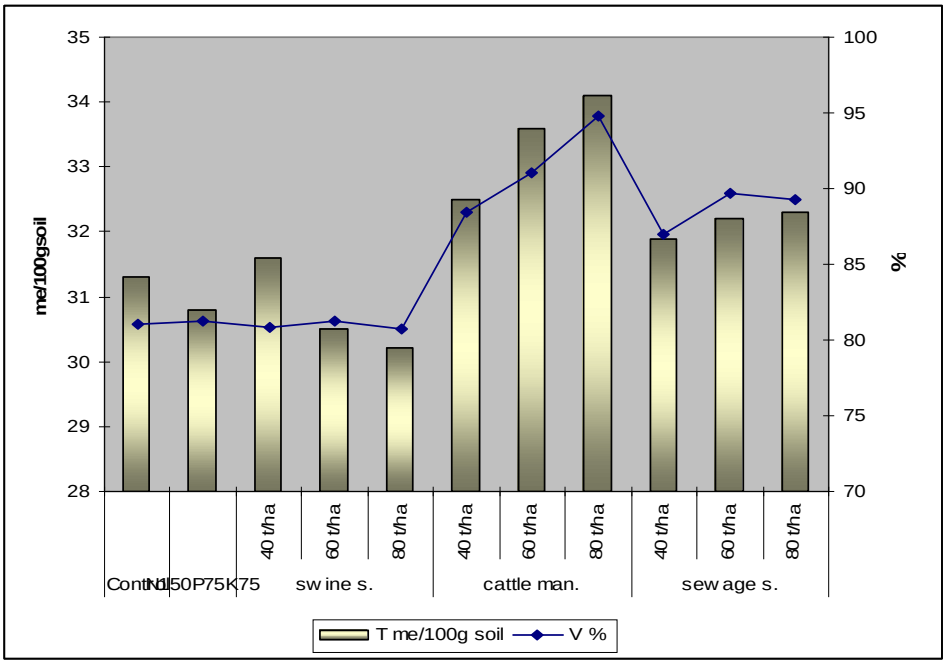

Fig. 3 Influence of residual organic fertilization upon total cationic exchange capacity and degree of base saturation

Highest total nitrogen content was determined in plot pre-fertilized with 80t/ha cattle manure (0.238%). In second year of application, cattle manure releases in soil 20% of his nitrogen content compared with only 5% in swine and sewage sludge case.

Swine sludge contains larger phosphorus amount between all organic fertilizers that we used, on plots pre-fertilized with swine sludge being determined highest soil phosphorus content, ranged between 16.8 – 18.6 ppm.

Pre-fertilization with organic fertilizers lead to determination of increasing potassium contents, from 148.3 ppm in control plot to 190.5 ppm in plot pre-fertilized with 80 t/ha cattle manure. Potassium values obtained in plots pre-fertilized with sewage sludge are lower than potassium value determined in standard mineral fertilization plot.

CONCLUSIONS

1. Organic residual fertilization of winter wheat leads to increased grain yields compared with control plot. In second year of application, the differences between doses are insignificant, no matter fertilizer type that we used.
2. Compared with mineral standard fertilization, only pre-fertilization with cattle manure lead to higher winter wheat grain yield.
3. Because of his weak alkaline reaction and high content of basic elements, cattle manure residual fertilization determined rise of pH, total exchange capacity, and degree of base saturation values.
4. Compared with control plot, organic residual fertilization increases soils nitrogen, phosphorus, and potassium content. Compared with mineral standard fertilized plot only pre-fertilization with high doses of cattle manure and sewage sludge (80 t/ha) determined rise of soil nitrogen content. Highest values of soils phosphorus and potassium content was obtained on plots with swine sludge, irrespective cattle manure residual fertilization.

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