THE EFFECT OF ORGANIC, ORGANO-MINERAL, COMPLEX AND LEAF FERTILIZATIONS ON MAIZE IN THE TRANSYLVANIA REGION

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ABSTRACT

The paper highlights the implementation of a soil fertilization system with ecological protection for maize crops in Transylvania in a climate favorable to maize cultivation in an area with high quality soils in terms of fertility and favorable for most cultivated agricultural and horticultural plants, maize being cultivated in this region on a considerable area. Along with the maize harvest, the export of mineral elements from the soil is very high, which determines the rapid impoverishment of the soil, being necessary a proper fertilization of the maize crop, in order to achieve quantitative and qualitative production of corn grains.

The specific nutrient consumption of corn, according to different authors, varies between: 20-30 kg N; 8-14 kg P2O5; 20-30 kg K2O; 10-14 kg CaO and 3.5-4.5 kg MgO, to achieve a ton of corn grains, needing large amounts of nutrients, throughout the growing season, to achieve the expected production. In this context, the paper aims to review Cojocna area, located in Cluj County, in the Transylvanian Plain, an area that nature has endowed with invaluable gifts, which lends itself to sustainable and profitable conservative agriculture. Soils, mostly of the faeoziom type, specific to this region, exhibit a high humus content, are well structured and aerated, which in terms of fertility are considered very productive. As a result of recent climate change and the specificity of the cambic faeoziom soils, which in the B cambic (Bv) horizon formed by altering the basic parent material "in situ", presenting in the upper part, dark brown colors followed by yellowish brown colors due to the accumulation of clay, which in conditions of heavy and long rains, favors the accumulation and puddle of water on the soil surface, which leads to asphyxiation and death of young plants, with undesirable consequences on the maize crop in the area. In this sense, it is known that corn is a plant species that resists well to unfavorable climatic conditions and also, has beneficial effects on all soils by improving aeration and soil structuring conditions, due to the well developed root system. The purpose of this paper is dedicated to the development of organic, organo-mineral, complex mineral and foliar fertilizations of maize crops in an area with high favorability for maize from Transylvania.

INTRODUCTION

From a nutritional point of view, corn is considered a plant that exhibits high demands on nutrients, being an annual species that exploits the land to a considerable depth, some roots reaching at the maturity of the plant about 1m deep and laterally at 90-100cm, but most of the plant's roots grow up to 20-30 cm. It forms an abundant vegetative mass and a high amount of corn grains per unit area. It is a large species that consumes nitrogen, phosphorus, potassium, calcium and magnesium, but also microelements and requires a careful and complex technology of maintenance and fertilization, to achieve superior production and quality.

At present, the lack of organic fertilizers in agricultural and horticultural crop cultivation technologies determines agricultural producers in our country to use unilateral plant fertilization systems, only with chemical fertilizers without a substantial organic support.

It is known that organic matter formed in the soil on account of natural organic fertilizers positively influences the physical, chemical and microbiological properties of the soil, reduces nutritional disorders and increases the effect of mineral fertilizers applied to supplement the need for plant nutrients, according to their specific and global consumption.

Starting centuries ago, the inhabitants of Cojocna area, where the research was carried out, have been engaged in agriculture, fruit growing and animal husbandry, an area characterized by a landscape of low hills, with flat and moderately sloping terrain.

MATERIAL AND METHOD

The experiments on the effect of organic, organo-mineral, complex mineral and foliar fertilizations on corn were designed multifactorially, located on an argic Faeoziom from the Cernisols class, on the Cojocna Farm of the Experimental Teaching Station within the University of Agricultural Sciences and Veterinary Medicine in Cluj- Napoca.

In order to achieve the objectives of the paper, several fertilization variants were designed, on the one hand complex, organo-mineral and organic mineral fertilization and on the other hand foliar fertilization, through which the impact of differentiated fertilizations on maize grain production and the modification of the main ones. agrochemical indices of the soil by mineral and organo-mineral fertilization in an area of Transylvania very favorable to maize cultivation.

- Complex mineral, organo-mineral and organic fertilization includes the following experimental protocol:

a) In the experiment with NP complex mineral fertilization the factors of the experiment are:
a1 – unfertilized control;
a2 - N50P50 (kg a.s./ha);
a3 - N100P100 (kg a.s./ha);
a4 - N150P150 (kg a.s./ha);
b) In the experiment with organo-mineral fertilization (semi-fermented manure) the factors of the experiment are:
b_1 - Manure-20t/ha;
b_2 - Manure-20t/ha+$N_{50}P_{50}$ (kg a.s./ha);
b_3 - Manure-20t/ha+$N_{100}P_{100}$ (kg a.s./ha);
b_4 - Manure-20t/ha+$N_{150}P_{150}$ (kg a.s./ha);
c) In the experiment with organo-mineral fertilization (semi-fermented poultry manure) the factors of the experiment are:
c1 - Poultry manure – 15t/ha;
c2 - Poultry manure – 15t/ha+N50P50 (kg a.s./ha);
c3 - Poultry manure – 15t/ha+N100P100 (kg a.s./ha);
c4 - Poultry manure – 15t/ha+N150P150 (kg a.s./ha);
d) In the experiment with organic fertilization the factors of the experiment are:
d_1 - Control – unfertilized;
d_2 - Manure-20t/ha;
d_3 – Poultry manure – 15t/ha;

- Foliar fertilization includes the following experimental protocol:

I) In the experiment fertilized only with foliar and non-fertilized soil, the factors of the experiment are:
e_1 - Control – unfertilized;
e_2 - Nutri Aid – 10-45-10 1%;
e_3 - Nutri Aid – 20-20-20 1%;
e_4 - Nutri Aid – 30-10-10 1%;
e_5 - Bio Activate 0,5%;
e_6 - Micoseed Plow 20g/m^2;
e_7 - F – 311 Hum 1%;
e_8 - F – 111 Hum 1%;
II) In the fertilized soil experiment: Complex 100-100-100 + foliar factors of the experiment are:
f_1 - Control : $N_{100}P_{100}K_{100}$ (kg a.s./ha) on soil;
f_2 - $N_{100}P_{100}K_{100}$ - sol +Nutri Aid – 10-45-10 1%;

f_3 - $N_{100}P_{100}K_{100}$ - sol +Nutri Aid – 20-20-20 1%;
f_4 - $N_{100}P_{100}K_{100}$ - sol +Nutri Aid – 30-10-10 1%;
f_5 - $N_{100}P_{100}K_{100}$ - sol +Bio Activate 0,5%;
f_6 - $N_{100}P_{100}K_{100}$ - sol+Micoseed Plow 20g/m^2;
f_7 - $N_{100}P_{100}K_{100}$ - sol +F – 311 Hum 1%;
f_8 - $N_{100}P_{100}K_{100}$ - sol +F – 111 Hum 1%;

RESULTS AND DISCUSSION

The influence of differentiated mineral and organo-mineral fertilization on the production of maize grains on the argic faeozem soil from Cojocna

The argic faeozem soil (SRTS-2003), respectively argiloiluvial chernozem (SRCS-1980), from a physical point of view (according to the pedological profile) has a medium to heavy texture, loam-clayey texture, with obvious compaction from the argiloiluvial horizon (Bv) as a result of the accumulation of clay, which can endanger the aerohydric regime and the porosity at the depth explored by the roots of the plants.

From the agrochemical analyzes performed, the significant contribution of the marly rock in the evolution of these soils is highlighted. The $CaCO_3$-rich marls, provide to the soil two essential properties, a medium to heavy texture and a high degree of base saturation.

Table 1

The pedo-agrochemical properties of the argic faeozem (argiloiluvial chernozem) soil from the Cojocna Farm plot

Horizon and depth (cm)		pH	Humus %	N total %	P mobil (ppm)	K mobil (ppm)	SH (me/100 g sol)	V%	Granulometric analysis					Texture
									Thick sand%	Fine sand %	Dust %	Clay %	D.a. g/cm³	
Am	0-20	7,40	4,90	0,286	19,7	129,26	1,87	92	1,11	31,2	22,2	30,6	1,03	LA
	20-45	7,50	4,61	0,188	23,2	137,19	1,96	94	1.12	32.3	23,8	31,6	1,22	LA
Bv	45-120	7,86	3,20	0,120	28,5	122,51	1,62	93	1.12	32.8	23,8	34,4	1,45	LA
C_{Ca}	120-140	7,90	-	-	-	-	0,68	95	0,21	33,7	24,4	28,3	1,50	A

From a pedo-agrochemical point of view, the argic phaeozem (argiloiluvial chernozem) from Cojocna area (Table 1) has a neutral to weak basic reaction. It is well supplied with humus, nitrogen and phosphorus and a very high potassium content. The degree of saturation in bases (V%) is high which explains the slightly basic character of the cambic phaeoziem. In the superficial horizon the soil is well structured and aerated with a clayey texture which creates the most favorable conditions for the development of plant roots. The fertility and productivity of this soil is very good, but in order to support a grain maize cultivation at the level of superior quantitative and qualitative productions, rational fertilization technologies are needed after a rigorous and complete agrochemical study carried out periodically.

Table 2

The effect of some mineral and organo-mineral fertilization systems on the production of maize grains (HT 300) on an argic faeozem – Cojocna

Fertilization		Grain production		Difference	
		kg/ha	%	kg/ha	Significance of difference
a. complec mineral NP					
1.	Control - unfertilized	6582	100	-	-
2.	$N_{50}P_{50}$	7347	112	765	**
3.	$N_{100}P_{100}$	7193	109	611	**
4.	$N_{150}P_{150}$	6735	102	153	*
Average – mineral NP		7092	108	510	
DL (5%) = 150; DL (1%) = 600; DL (0.1%) = 810					
b. organo – mineral (semi-fermented manure)					
1.	Manure-20t/ha	7653	100	-	-
2.	Manure-20t/ha+$N_{50}P_{50}$	7806	102	153	*
3.	Manure-20t/ha+$N_{100}P_{100}$	8112	106	459	**
4.	Manure-20t/ha+$N_{150}P_{150}$	7959	104	306	**
Average – manure + NP		7959	104	306	
DL (5%) = 150; DL (1%) = 300; DL (0.1%) = 460					
c. organo – mineral (semi-fermented poultry manure)					
1.	Poultry manure – 15t/ha	7500	100	-	-
2.	Poultry manure – 15t/ha+$N_{50}P_{50}$	7806	102	306	*
3.	Poultry manure – 15t/ha+$N_{100}P_{100}$	8572	114	1072	***
4.	Poultry manure – 15t/ha+$N_{150}P_{150}$	8112	108	612	**
Average – Poultry manure + NP		8163	108	663	
DL (5%) = 300; DL (1%) = 680; DL (0.1%) = 1010					

d. organic					
1.	Control - unfertilized	6582	100	-	-
2.	Manure-20t/ha	7653	116	1071	-
3.	Poultry manure – 15t/ha	7500	114	918	-
Average – organic fertilization		7577	115	995	

The superior effect of organo-mineral fertilizations is obvious, regardless of the nature of the insured organic component (manure or poultry manure), on grain production, the fertilizing superiority of this interaction being net. Through these organo-mineral fertilization systems, yields of 6.6 - 8.5 t/ha are obtained, sufficiently stable. The complex mineral fertilization (NP type) ensures the production of 6.6 - 7.0 t/ha of maize grains.

The superiority of organo-mineral fertilizers is determined, however, by some positive effects, extremely important, for soil fertility (Table 3).

Table 3

Modification of the main agrochemical indices by mineral and organo-mineral fertilization on the argic faeozem – Cojocna

Fertilization		Agrochemical indices of the soil							
		pH_{H2O}	$N\text{-}NO_3$ ppm	N-mineral rezidual kg/ha	C-organic %	Humus %	I_N	P-AL ppm	K-AL ppm
a. complex mineral NP									
1.	Control - unfertilized	8,13	1,4	42	3,38	5,82	5,70	248	820
2.	$N_{50}P_{50}$	7,94	2,4	72	3,36	5,80	5,68	282	860
3.	$N_{100}P_{100}$	7,60	8,8	264	3,31	5,70	5,58	256	826
4.	$N_{150}P_{150}$	7,65	8,5	255	3,35	5,78	5,64	278	864
Average – mineral NP		7,73	6,6	197	3,34	5,76	5,63	272	850
b. organo – mineral (semi-fermented manure)									
1.	Manure-20t/ha	8,13	1,7	51	3,41	5,88	5,52	263	846
2.	Manure - 20t/ha+$N_{50}P_{50}$	8,29	1,7	51	3,36	5,78	5,67	350	810
3.	Manure - 20t/ha+$N_{100}P_{100}$	8,16	3,1	93	3,17	5,46	5,35	303	828
4.	Manure - 20t/ha+$N_{150}P_{150}$	7,90	3,1	93	3,65	6,30	6,17	320	878
Average – Manure + NP		8,11	2,6	79	3,39	5,84	5,73	324	838
c. organo – mineral (semi-fermented poultry manure)									
1.	dejecţii avicole – 15t/ha	8,04	1,4	42	3,52	6,06	5,93	270	830
2.	dejecţii avicole 15t/ha+$N_{50}P_{50}$	8,22	1,4	42	3,12	5,38	5,17	288	812
3.	dejecţii avicole 15t/ha+$N_{100}P_{100}$	7,77	4,4	132	3,13	5,46	5,29	278	814
4.	dejecţii avicole 15t/ha+$N_{150}P_{150}$	7,50	7,5	225	3,58	6,18	6,05	276	846
Media – dejecţii avicole + NP		7,82	4,4	133	3,28	5,67	5,50	281	827
d. organică									
1.	Martor - nefertilizat	8,13	1,4	42	3,38	5,82	5,70	248	820
2.	Gunoi de grajd-20t/ha	8,13	1,7	51	3,41	5,88	5,52	263	846
3.	dejecţii avicole – 15t/ha	8,04	1,4	42	3,52	6,06	5,93	270	830
Media - fertilizare organică		8,09	1,6	47	3,47	5,97	5,73	267	838

The intervention of the organic support of the organo-mineral fertilizers influences, positively and decisively, the amount of humus organic matter in the soil. Phosphorus and potassium reserves change significantly and a trend of soil acidification can be predicted as NP intake increases.

As the fertilization formulas are differentiated, quantitatively and by assortment, the regime of accumulation of nutrients in the soil changes substantially depending on the doses administered and their nature (Table 4).

Table 4

Effect of foliar fertilization on maize grain production (HT 300) on an argic phaeozem – Cojocna

Fertilization		Grain production		Difference	
		kg/ha	%	kg/ha	Significance of difference
• **Unfertilized at soil**					
1.	Control - unfertilized	5600	100	-	-
2.	Nutri Aid – 10-45-10 1%	6400	114	800	*
3.	Nutri Aid – 20-20-20 1%	6450	115	850	*
4.	Nutri Aid – 30-10-10 1%	6000	107	400	-
5.	Bio Activate 0,5%	7240	129	1640	***
6.	Micoseed Plow 20g/m^2	6820	122	1220	**
7.	F – 311 Hum 1%	6460	115	860	*
8.	F – 111 Hum 1%	6440	115	840	*
Average – foliar		6544	117	830	-
DL (5%) = 720; DL (1%) = 1200; DL (0.1%) = 1540					
• **Soil fertilization: Complex 100-100-100**					
1.	Martor : $N_{100}P_{100}K_{100}$ - sol	6400	100	-	-
2.	$N_{100}P_{100}K_{100}$ - sol +Nutri Aid – 10-45-10 1%	7200	113	800	**
3.	$N_{100}P_{100}K_{100}$ - sol +Nutri Aid – 20-20-20 1%	6860	107	460	*
4.	$N_{100}P_{100}K_{100}$ - sol +Nutri Aid – 30-10-10 1%	6450	101	50	-
5.	$N_{100}P_{100}K_{100}$ - sol +Bio Activate 0,5%	7620	119	1220	***
6.	$N_{100}P_{100}K_{100}$ - sol +Micoseed Plug 20g/m^2	7290	114	890	**
7.	$N_{100}P_{100}K_{100}$ - sol +F – 311 Hum 1%	6860	107	460	*
8.	$N_{100}P_{100}K_{100}$ - sol +F – 111 Hum 1%	7290	114	890	**
Average NPK + foliar		7081	111	681	-
DL (5%) = 420; DL (1%) = 780; DL (0.1%) = 1050					

The production results of the experiments exhibit that the main implementation solution that determines significant effects on agricultural yields (corn grain production) is organo-mineral fertilization in which organic nutrient support is provided by two resources - semi-fermented manure and semi-fermented poultry manure. In implementing the organo-mineral fertilization solutions and achieving the positive interaction of the two fertilization measures (organic and mineral), the organic resources involved have the main and decisive role in the productive use of fertilizers and the achievement of multiple effects on production.

CONCLUSIONS

These productive results of fertilization solutions obviously differ according to the effects they determine in soil chemistry and fertility:

- organic fertilizing resources have effects of protection and amelioration of soil reaction, first of all noticed this effect in semi-fermented manure. Organic fertilizing compounds have essential cations and exert chelating and neutralizing effects on indicators - acidity factors;
- exclusively mineral fertilization, even complex NP type, determines acidification effects on the soil reaction;
- nitrate dynamics is extremely active in the alternative of mineral fertilization and the amount of N-mineral (residual) determined on the agricultural profile of the soil, at high doses of NP, can determine the effects of excess nitrates;
- the organic fertilizing resources maintain, especially the manure, the accumulation parameters and the level of N-mineral, at normal values or close to this amount;
- organic resources become the most active nutritional sources and much more stable, especially when associating organic fertilization with mineral fertilizers, alternatives in which the mineralization of the organic component can be primed - enhanced by the mineral fertilizer;
- under these conditions, although of some soils with high fertilization and productive potential, the exclusively foliar fertilization determines inferior results to the organo-mineral and mineral solutions applied to the soil. It is possible that a normal and optimal level of fertilization applied to the soil will increase the effect of unconventional fertilization.
- maize is a crop that responds efficiently to the organo-mineral application of fertilizers and then to the complex mineral NP type;
- fertilization interventions through organic resources have positive effects not only on grain production but also on soil fertility;
- in the conditions in which the exclusively mineral fertilization increases the rate of humus mineralization and the soils tend to reach a minimum humus balance, the attraction of humus organic resources in the fertilization systems becomes stringent.

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