RESEARCH REGARDING THE ORGANO-MINERAL FERTILIZATION EFFECT ON THE MAIZE PRODUCTION AND ON THE ACCUMULATION OF NUTRIENTS IN CORN LEAVES FOR IDENTIFYING SOME NUTRITIONAL DISORDERS (POTASSIUM DEFICIENCY)

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Abstract: *The quantitative and qualitative increase of the agricultural production is an important concern world wide. In the context of the world's increasing population, of the prognosis according to which the world's population will double until 2030 and of the diversification of requirements for agricultural raw materials in industry, the agricultural development becomes a primary goal at a global level and also at a local level for each country in particular. In terms of scientific foundation of the complex effects in the food chain, all agricultural systems are perfectible and can't fully achieve the objectives imposed by the human society, by the consumers and by the increasing requirements for the soil fertility. Through this study we want to clear some aspects concerning the organo-mineral fertilization effect on the maize production, hybrid-Monsanto Dekalb 4626, having a production potential of 8-14 t/ha. The experiments were conducted in 2012 on a chernozem type of soil (SRTS-2003), having a high towards a very high production potential. The vegetation period in 1012 was characterized by less favorable climatic conditions for obtaining a big, quality production due to a low rate of precipitation (much below the regular rate for that specific time of the year) and also due to high temperatures, events that led to productions that were very much below the production potential of the hybrid used in the experiments (2,6 – 4,6 t/ha maize). The differentiated fertilization variants included effects of mineral fertilizers originated from mineral NP fertilizers (in differentiated doses), of organic fertilizers originated from partially fermented stable manure (20t/ha) and partially fermented poultry manure (12t/ha). The production results revealed the beneficial nature of the organic-mineral combinations, where significant production increases were obtained in comparison with the unfertilized witness variant, below the production potential of this hybrid. The unfavorable climatic conditions led to an incomplete binding in the fructification phenophase, in some variants and at the variants that were fertilized with a maximum NP dose during the blooming phenophase, to the specific symptom in potassium deficiency, meaning that the "marginal necrosis" in corn leaves was emphasized. The agrochemical analysis on the corn leaves showed, at the variants that were fertilized with 150-200 kg active substance/ha, nitrogen and phosphorus, an accumulation that was close to the critical threshold regarding the nitrogen level and low towards poor regarding the potassium level. The importance of this study is resulting from the link between the accumulations of nutrients in corn plants at different nitrogen doses and climatic conditions during the corn vegetation period, even though the soil has an optimum level of nutrients from an agrochemical point of view.*

Key words**:** *productions, nutrients, nutritional disorders, potassium deficiency, maize*

INTRODUCTION

The nutritional substrate of crops provided by the natural representation of nutritional elements, enriched through differentiated fertilizations can substantially alter the absorption, translocation and accumulation regime of nutrients in the plants in general and differentiated in various plant organs. (Dorneanu A. et al., 2006), (Epstein E., 1972).

Corn, which is considered to be a crop with a high level of nutrients consumption, responds in a quantitative and also in a qualitative way to the effect of the agrochemical level of the soil. It is essential that, from a nutritional point of view and also from a qualitative point of view, the fertilizers and the nutrients applied are productively used on this specific type of crop and it is also essential that through nutritional indicators, control and prevention formulas of some phenomena or risk areas due to the uncontrolled application of the fertilizers, can be emitted.

The differentiated application of fertilizers on corn essentially alters the nutritional level and also the accumulation of nutrients in the leaves and further in the maize.

MATERIAL AND METHODS

Experiments were placed in 2012 at SDE Cojocna of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, on a cambic chernozem soil, exhibiting the following physico-chemical traits (table 1):

Table 1.

Pedo-agrochemical traits of the chernozem (SRTS – 2003) – Cojocna

Determining indicator		Horizon/Depth(cm)				
		Amp 0-25	Am 25-40	AC 40-56	C_1 56-78	C_2 78-130
Physico-chemical traits						
pH_{H2O}		7,40	7,50	7,86	7,90	7,85
$CaCO_3$ %		0,4	0,6	3,0	10,4	14,9
Humus (%)		7,10	5,45	2,20	1,13	-
P – AL (ppm)		13,0	3,1	10,0	3,0	6,1
K – AL (ppm)		330,3	180,1	131,1	93,0	117,8
Da (g/cm^3)		1,04	1,15	1,31	1,42	1,48
Granulometric analysis %	Coarse sand (2,0-0,2 mm)	8,9	10,8	15,5	0,5	0,7
	Fine sand (0,2-0,0 mm)	28,9	25,5	27,4	17,7	14,4
	Dust (0,0-0,002)	16,9	12,5	17,8	36,0	38,9
	Clay (<0,002 mm)	45,3	45,2	39,3	45,8	46,0

From a physical point of view, the soil exhibits a high quantity of clay, with a clayey texture from surface horizons. Thus, it has a high cation exchange ability, but alsoa high water retention potential, which limits the airhydric regime of the soil. On the surface, the soil has an apparent low density, which reduces porosity and enhances compaction.

From an agrochemical point of view the soil exhibits a weal alkaline reaction, a high humus content, a low P and high K content. It shows good fertility and productivity.

The corn seed used in the experiments – Hibrid - Monsanto Dekalb 4626, early, certified in Romania, in 2004, with a production potential of 8-14 t/ha maize.

Field experiment pattern and variants have included differentiated fertilization factors achieved through the employment of complex NP mineral fertilizers (20-20), organo-mineral ones (with an organic support formed of semi-fermented stable manure or poultry manure in interaction with complex NP mineral fertilizers), as well aas organic ones (semi-fermented stable manure - 20t/ha and poultry manure 12t/ha (according to the following pattern:

- V_1 = Unfertilized control;
- $V_2 = N_0P_0$+12t/ha poultry manure;
- $V_3 = N_0P_0$+20t/ha stable manure;

- $V_4 = N_{50}P_{50}$+12t/ha poultry manure;
- $V_5 = N_{50}P_{50}$+20t/ha stable manure;
- $V_6 = N_{50}P_{50}$;
- $V_7 = N_{100}P_{100}$;
- $V_8 = N_{150}P_{150}$;
- $V_9 = N_{200}P_{200}$;

The agrochemical analysis of the vegetal material was conducted in the Soil-Plant Analysis Laboratory, at USAMV Cluj-Napoca, Agrochemistry Department, using the methodology recommended by ICPA for agrochemistry and pedology laboratories:

Nt - through Kjeldahl method;

Kt – through flame fotometry on the acid extract of vegetal ashes;

RESULTS AND DISCUSSIONS

The analysis of maize productions that were obtained and determined by the applied fertilizations differ in direct dependence with the nature of the fertilizations and the applied doses.

The organo-mineral fertilization is essential as a way of fertilization because it positively develops the two fertilizing resources (complex organic and complex mineral) which mutually emphasize their effect especially at the application of complex fertilizers in moderate doses ($N_{50}P_{50}$). It is implied that the productivity of this intervention is more effective and positively exploited in the case of organo-mineral combinations, both for poultry manure and stable manure (table 2).

Table 2.

Production results regarding the organo-mineral fertilization effect on maize (year 2012), (Hibrid - Monsanto Dekalb 4626)

N.	Fertilization variant	Maize average production				
		t/ha	%	Difference t/ha	The difference significance	Observations
1	Control	3,23	100,0	0,00	Mt.	
2	12t/ha poultry manure	3,55	109,8	0,32	*	
3	20t/ha stable manure	3,60	111,6	0,37	*	
4	12t/ha poultry manure + $N_{50}P_{50}$	4,02	124,5	0,79	***	
5	20t/ha stable manure+ $N_{50}P_{50}$	4,63	143,3	1,40	***	
6	$N_{50}P_{50}$	3,14	97,2	- 0,09	-	Weak binding
7	$N_{100}P_{100}$	3,92	121,3	0,69	***	
8	$N_{150}P_{150}$	4,46	138,0	1,23	***	K deficiency
9	$N_{200}P_{200}$	2,66	82,4	- 0,57	00	Weak binding + K deficiency

DL(5%) = 0,30; DL(1%) = 0,42; DL(0,1%) = 0,58

The organo-mineral fertilization is decisive in developing high productions when cultivating corn because it ensures a great interaction between NP mineral elements (at a complex level) and the applied organic substrate. It can be also mentioned that applying only stable manure or only poultry manure without any NP mineral contribution doesn't achieve significant productions in comparison with the unfertilized witness.

The complex mineral fertilization is significantly effective even among the first NP doses, this proving that the soil responds positively to the application of mineral elements which are provided for the plants from the early vegetation phenophases, but in optimal climatic conditions. Due to unfavorable climatic conditions during the vegetation period, the maize productions were very much below the production potential of this hybrid.

Table 3.

The differentiated fertilization influence on the Nt (%) and Kt (%) content in corn leaves at identifying some visible symptoms on the leaves in case of nutritional disorders (K deficiency – marginal leaf necrosis)

N.	Fertilization variant	Normal values (according to different authors)		Obtained values	
		Nt %	K_t %	Nt %	K_t %
1	Control	0,8 – 1,3	1,1 – 1,6	1,5	1,2
2	12t/ha poultry manure			1,9	1,9
3	20t/ha stable manure			1,6	1,8
4	12t/ha poultry manure + $N_{50}P_{50}$			2,4	1,8
5	20t/ha stable manure + $N_{50}P_{50}$			2,3	1,7
6	$N_{50}P_{50}$			2,0	1,6
7	$N_{100}P_{100}$			2,9	1,4
8	$N_{150}P_{150}$*			3,6	1,05
9	$N_{200}P_{200}$*			3,9	0,9

* - Variants for specific symptom potassium deficiency (marginal leaf necrosis)

Also due to unfavorable climatic conditions, at some variants ($N_{50}P_{50}$, $N_{200}P_{200}$), the fructificaton phenophase binding was incomplete and at the high NP doses ($N_{150}P_{150}$ – $N_{200}P_{200}$), the potassium deficiency was highlighted on the corn leaves, which led to an analysis of the N_t and K_t content accumulated in the corn leaves. (table 3).

CONCLUSIONS

The production results in 2012, year in which the research was conducted, where very much below the production potential of the hybrid used (8-14 t/ha maize), due to unfavorable climatic conditions, with a low level of precipitation and high temperatures, events that led to a low mobilization rate of the nutrients in the soil and a low rate of variability of the pollen when binding.

Concerning the analysis conducted on the corn leaves (the beginning of blooming-to highlight the potassium deficiency) the N content shows increases first of all at organo-mineral fertilizations and higher increases at the NP doses increase, the two essential elements are mutually highlighting each other's absorption and accumulation.

In terms of potassium, the accumulation of this cation, although it systematically increases together with the organic fertilizations, organo-mineral and NP mineral fertilizations, marks a possible reduction due to very high NP doses. In general, the accumulation of potassium is close to the field of this element's deficiency (critical threshold = 1,5%) because the chernozem from Cojocna holds more than 45% clay in its content, this showing that this cation is able to participate in the soil, to accumulations in unchangeable forms and its mobilization in bio-accessible forms is more difficult also due to atmospheric and soil drought.

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