RESEARCH ON ALTERNATIVES AND STRATEGIES FOR FOLIAR FERTILIZATION WITHIN DIFFERENTIATED FERTILIZATION SYSTEMS FOR MAIZE CROP

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Abstract: *Foliar fertilizers are unanimously considered stimulating and corrective products for mineral nutrition. They exhibit a secondary fertilizing role, that determines a significant increase of the productive consumption for soil elements and soil-applied elements without substituting root fertilization methods (through the soil), where foliar fretilizers are supplementary (complemantry) in balancing and optimizing the fertilization system applied to agricultural and horticultural plants (Ryan J., 2002), (Rusu M. et al., 2008), (Dana Daniela et al., 2008), (Dorneanu A. et al., 2005). The aim of the hereby research envisions the rationalization of mineral fertilizing inputs and their reduction, by means of promoting an alternative, as well as strategies for an efficient involvemen of unconventional resources (foliar fertilizers) in the differentiated fertilization systems. Throughout the research period the effect of differentiated fertilizations were studied by pursuing the differentiation of maize grain productions according to the type of foliar fertilizer employed and the interaction of foliar fertilization within the structure of soil fertilization systems. In order to achieve the previously-stated research objectives field experiements were conducted at SDE Cojocna of the University of Agricultural Sciences and Veterinary Medicine, in 2011. They were set on a cambic chernozem, for maize crop, involving different foliar fertilizer varieties, devoid of soil fertilization, as well as testing these fertilizers in interaction with the basic soil fertilization in doses of 100 kg/ha s.a. N and P. Production results obtained as a consequence of the experimentation reveal the essential character of foliar fertilization, alongside and optimum provision of nutritive elements. The application of foliar fertilizers in plants has had a complementary sole providing higher coefficients for the employment of the active substance in the soil or applied to the soil. These experiments in researching the effects of unconventional fertilization sources (foliar fertilizers) grant a special importance, originality and high degre of novelty on the field of agrochemistry, due to the fact that new foliar fertilizer varieties were employed with different combinations of nutrients in the mixture. The paper was supported by the project – POST-DOCTORAL SCHOOL IN THE FIELD OF AGRICULTURE AND VETERINARY MEDICINE Contract n.: POSDRU/89/1.5/S/62371*

Key words**:** *productions, nutrients, foliar fertilizers, fertilization*

INTRODUCTION

Maize is considered to be a *voracious* pant by excellence, consuming high amounts of nutritive substances for production (ANGELINI, 1965 quoted by BÂLTEANU, 1998).

A great part of this nutritive consumption is provided by the soil reserve, while the other needs to be applied by the grower during the cultivation technology in the form of different fertilizers. The plant's specific consumption, calculated as the arithmetic mean of limit values in the case of the three primary marcoelements is 25.5 kg N/t product, 12.0 kg P_2O_5/t product and 28.0 kg K_2O/t product (MĂRGHITAŞ MARILENA, M. RUSU 2003, M. RUSU et al. 2005). Therefore, this need has to be provided regardless of the ferilization method and fertilizeer combinations.

Within fertilizer combinations, one should include foliar fertilization as supplementary fertilization to the soil-applied one. Its efficiency is highly-dependant on soil

humidity, water quantity in the plants and the moment of application. They positively influence the absorption, translocation and accumulation of nutrients in plant organs (M. RUSU et al. 2005).

MATERIAL AND METHODS

Experiments were set at SDE Cojocna of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, in 2011 on a cambic chernozem exhibiting the following pedo-agrochemical 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.

Field experiment pattern and variants have included differentiated fertilization factors achieved through the employment of complex NP mineral fertilizers (20-20), and foliar ones with different foliar fertilizer varieties and different combinations, as follows:

1. Soil fertiliation for the previous plant ($N_{100}P_{80}$) and foliar fertilization:
   - V_1 = Unfertilized control;
   - V_2 = Microfert Zn 0,5% (2 treatments);
   - V_3 = Microfert Zn 1% (2 treatments);
   - V_4 = Ferticig 19-19-19 0,3% (2 treatments);
   - V_5 = AH 1 0,5% (2 treatments);
   - V_6 = AH u 0,5% (2 treatments);

1. Soil and foliar frtilization ($N_{100}P_{100}$+foliar variety):
   - V_1 = Unfertilized control;
   - V_2 = Microfert Zn 0,5% (2 treatments)+ $N_{100}P_{100}$;
   - V_3 = Microfert Zn 1% (2 treatments)+ $N_{100}P_{100}$;
   - V_4 = Ferticig 19-19-19 0,3% (2 treatments);+ $N_{100}P_{100}$;
   - V_5 = AH 1 0,5% (2 treatments)+ $N_{100}P_{100}$;
   - V_6 = AH u 0,5% (2 treatments)+ $N_{100}P_{100}$;

RESULTS AND DISCUSSIONS

Maize, which is a highly-demanding plant with average and high specific and global consumptions is able, especially in certain agrochemical conditions and for high quality grains, to capitalize on the application of foliar fertilizers that are optimally included in the structure of soil-applied fertilization systems.

The results obtained through the application of a wide variety of foliar fertilizers on maize crop, in 2011 have highlighted the productive effect of these fertilizers, differentiated according to the category of foliar fertilizer and the conditions of application (table 2).

Table 2.

Production results on the efect of foliar fertilization in maize grains (2011), (Hybrid - Monsanto Dekalb 4626)

N.	Fertilization variant	Average maize grain production				
		t/ha	%	Difference t/ha	Significance of difference	Duncan Test
1	Martor	7.24	100,0	0,00	Mt.	A
2	Microfert Zn 0,5%	7.32	101.2	0.08	-	A
3	Microfert Zn 1,0%	7.76	107.3	0.53	***	B
4	Ferticig 19-19-19	8.15	112.6	0.91	***	C
5	AH 1	7.54	104.3	0.31	***	D
6	AH u	7.65	105.7	0.41	***	E
7	Microfert Zn 0,5% +N100P100	10.65	147.1	3.41	***	F
8	Microfert Zn 1,0% +N100P100	10.76	148.7	3.52	***	G
9	Ferticig 19-19-19 +N100P100	10.64	147.0	3.40	***	H
10	AH 1 +N100P100	9.29	128.3	2.05	***	H
11	AH u +N100P100	9.71	134.2	2.48	***	I
	DL(5%)		0,10			
	DL(1%)		0,13			
	DL(0,1%)		0,18			

The differentiation of the effects obtained through the application of foliar fertilizers and the level of grain production are highly dependant on the application of these fertilizers where there is a nutritive balance between esssential macroelements, or there is a predominace in the mixture, of zinc, due to the fact that this microelement is highly cosumed by maize compared to other plants. These results show that the effect of foliar fertilizers applied is first due to the involvement of the mixture in element cycle and assimilation that can be capitalized and supported at an optimal level through the simultaneous representation of nitrogen, phosphorus, and potassium in their composition.

In the same context, it ca be assessed that the effect of foliar fertilizer application is significantly provided and determined by complex NP fertilization applied to the soil, The resultsobtained confirm other research showing that the effect of foliar fertilizer can be ascertained when the soil has a god nutrient supply or this agrochemical situation os determined by previous fertilizations or simultaneous to the technology in question (RUSU M. et al., 2008), (BIVEESCU GEANINA et al., 2006), (BORLAN Z. et al., 1995).

The results obtained show and recommend the inclusion of foliar fertilizers in maize fertilization technologies, thus providing practical variants for differentiated fertilization- soil and foliar- that may capitalize on the productive potential of both the soil and the plant, as well

as the synergic or interaction effects of soil-applied fertilizer varieties, as well as extraradicular ones.

Production and production increases diversification as an effect of foliar fertilization is highly significant and can be displayed as an alternative to the employment of these fertilizing resources devoid of an adequate soil fertilization system, as it was previously stated, as the latter enhances and supports the effect of foliar fertilizers (figure 1).

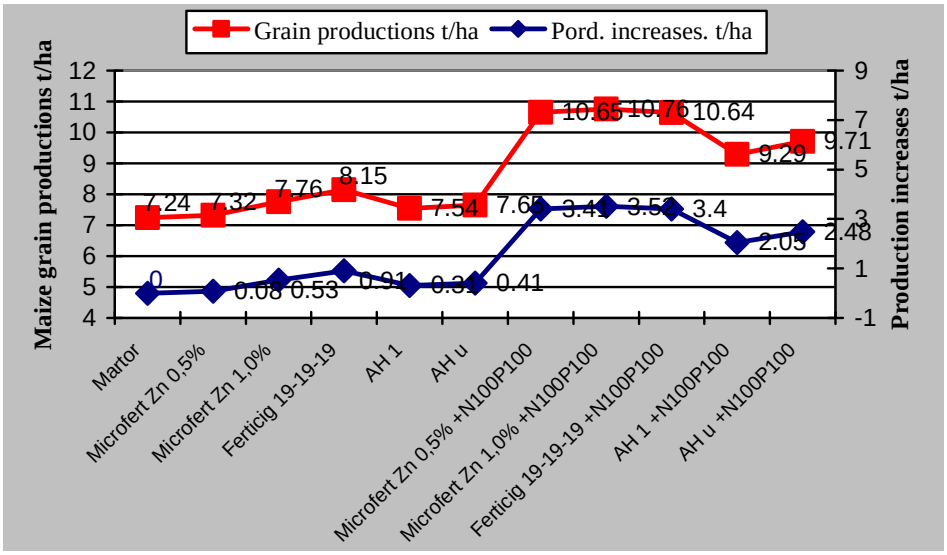

Figure 1 Effect o foliar fertilization in maize grains on the production and production increases (2011), (Hybrid - Monsanto Dekalb 4626)

The production increases and grain production curve clearly shows that for crops that intensively exploit the soil and fertilization, solely foliar fertilizers devoid of an agrochemical optimum provided to the soil, does not provide the best production results. They are always inferior to those obtained by means of fertilization solutions that involve an interaction of soil and foliar fertilization. In time, this interaction and its capitalization on a superior level allow for a resizing of soil-applied doses, towards their reduction and providing a better and more productive employment of soil or soil-applied nutrients through foliar fertilizers. Thus, the two methods of fertilization- soil and foliar- may mutually determine their effects and efficiency (on an agronomic, agrochemical and economic level).

CONCLUSIONS

Maize can significantly capitalize on the application of foliar fertilizers that are optimally included in the structure of soil fertilization, but exhibiting a secondary and corrective character compared to the main soil-incorporated one. The favourable effect of foliar fertilization is conditioned by the optimal soil representation of nutritive elements.

In the case of the application of a suitable soil fertilization, the effect of foliar fertilization is short term or not provided at maximal parameters of efficiency, especially as this plant, maize, exhibits average and high nutrient consumption and high nutrient absorption pace during the growth phenophases and maximal upon blooming.

Maize shows an efficient response, by producon increass and balanced nutrition, to

fertilization systems based on the application of complex NP soil fertilizers and on their interaction with foliar fertilization.

One-sided and exclusive foliar fertilization does not provide significant increases of production, which justifies their secondary role compared to complex mineral and balanced NP fertilizatio applied to the soil.

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