THE EFFECT OF FOLIAR FERTILIZATION ON THE YIELD, CHEMICAL COMPOSITION AND NUTRIENT VALUE OF MAIZE

PÉTER JAKAB[1], ÁGNES SÜLI[1], PIROSKA NAGY[2], ISTVÁN KRISTÓ[3]
[1] University of Szeged, Faculty of Agriculture
jakabpeter@mgk.u-szeged.hu
[2] College of Szolnok, Szolnok
[3] Hungarian Chamber of Agriculture, Food and Rural Developement, Csongrad County, Szeged

Abstract: *We examined the effect of foliar fertilization on the yield, chemical composition and nutrient value of maize hybrids in 2013. The yield of the control plots ranged between 9.9-11.8 t/ha, the yields of the foliar fertilization plots ranged between 10.3-11.47 t/ha. There were not significant differences between the average yields of control and foliar fertilization plots. By the application of foliar fertilization the yield fluctuation decreased. The results of chemical composition analysis showed significant differences on LSD 5% of crude fat content, which increased from 38 g/kg of control to 45 g/kg of treated maize. The N-free extracts decreased with 1.6% from 709.3 g/kg to 698 g/kg respectively which was also significant. There was no significant differences in the other components and DE and ME content of them.*

Keywords: *maize, yield, foliar fertilization, chemical composition, nutrient value*

INTRODUCTION

The nutrient supply is one of the most important agrotechnical elements of maize production. Numerous researchers have been involved in determining the optimum NPK fertilizer doses for the different maize hybrids.

Considering the aspects of efficiency and environment protection, maize needs only N_{60-120}, $P_2O_{5\ 45-90}$, K_2O_{53-106} kg ha^{-1} active agent. With N doses larger than N_{60-120} kg ha^{-1} the quantity of NO_3-N reaches 150-200 mg kg^{-1} in the 100-120 cm soil profile which can result in marked environment pollution (Sárvári, 1995).

In the N_0 treatment, the yield decreased gradually and the cumulated yield difference was 74.0 t ha^{-1} as compared to the basis treatment (N_{80}). In the average of 1970-1991, the grain yield of maize (t ha^{-1}) was the following as per N-treatments: N_0: 3.56, N_{80}: 6.93, N_{160}: 8.12 and N_{240}: 8.00. In the N_{160} treatment the yield surpassed that of N_{240} treatment after the 13th year of the trial, and the cumulated extra yield was 26.3 t ha^{-1} in comparison with the basis treatment. In wet years, the grain yield of maize was higher depending on the N-treatment by 1.13-2.28 t ha^{-1} than in the dry years (Berzsenyi, 1993).
Dobos-Nagy (1998) examined the effect of year and fertilisation on the dry matter production of the maize hybrid Volga SC on a 5-year series of data in four replications, including two favourable and three unfavourable years, without fertilisation and with a fertiliser treatment involving 120 kg ha^{-1} N+ 90 kg ha^{-1} P_2O_5 + 106 kg ha^{-1} K_2O.

In the unfertilised treatment there was a significant difference in the dry matter content of the maximum vegetative mass in the years examined. In the fertilised treatment higher values were recorded each year than in the control plots, the fertiliser effect being 17-19 % in 1991, 1993 and 1994 and 22-28 % in 1992 and 1995.

Nagy (1995) determined the profitable fertilizer rate in production practice, based on the experimental data, the fertilizer active agent quantities belonging to 10 kg grain yield were fixed, and these values can be converted to different economic circumstances, as well. The fertilizer rate belonging to 10 kg marginal efficiency in the non-irrigated treatment, during four years, was 111 kg ha^{-1} N (its extreme values being 89-125 kg). In

the irrigated treatment, on average a rate of 158 kg ha^{-1} N met the condition of 10 kg marginal efficiency, which varied between 147 kg and 170 kg. It was stated, that based on the experimental data - on similar production site - without irrigation a rate of 90-120 kg ha^{-1} N and in irrigated production a rate of 150-170 kg ha^{-1} N may be a normal dose.
Kádár (2008) says that the macro and micro element requirements of most arable crops can be satisfied through soil. The future spread of foliar fertilisation must be grounded by comprehensive experimental research. Accurate, repeated small plot trials are necessary to clarify the factors influencing the effectiveness of foliar fertilizers and recommendations must be developed for consultation.

MATERIAL AND METHODS

Soil properties of the experimental field

We set the experiment on the area of an ecological farm in Kútvölgy. The soil was chernozem, the reaction of which was nearly neutral (pH_{KCL} 6.86). Before setting the experiment the soil analysis data showed that it had proper nitrogen, plenty phosphor and very good potassium contents (*Table 1*).

Table 1.

Main properties of the experimental field area

pH (H_2O)	P_2O_5 (mg/kg)	K_2O (mg/kg)	Humus (%)	Soil plasticity value (K_A)
6.86	604	653	2.8	42

Weather in the experimental years

The year 2013 was unfavourable for maize production. In 2013 the amount of precipitation in the graining phase of maize (July and August) was lower by 59 mm than the average. Totally, we can say that low precipitation had a negative effect on the development of maize (*Table 2*).

Table 2.

The distribution of precipitation in the vegetative period of maize in 2013

Month	Rainfall (mm)	Average rainfall (mm)	Difference (mm)
April	41	42	-1
May	91	47	+44
June	79	72	+7
July	11	60	-49
August	44	54	-10
September	42	32	+10
Total amount of rainfall (mm)	**308**	**307**	**+1**

Main features of the agro-technology applied

Our small-scaled plough experiment was set in three replications, organised as a random block in 2013. We applied foliar fertilization treatments, which we supplemented with a control plot. The amount of nitrogen was applied in autumn and spring in 50-50%; the total amount of phosphorus and potassium was applied in autumn in one dosage. The foliar fertilization was applied twice (15 of May, 6 of June) in a dosage of 5-5 l/ha. The fore-crop was winter wheat. Fall tillage involved deep ploughing at 32 cm depth in the experimental years. The maize hybrid in the experiment was Finkass. We processed the obtained data by single factor variant analysis (SVÁB, 1981).

Laboratory analyses

The laboratory analyses have done in feed analyses laboratory of University of Szeged Faculty of Agriculture The applied methods: Dry matter MSZ 6830/3-84, crude protein Kjeldahl system, crude fat Pabulus Hungaricus (2004), crude fiber MSZ 6830/7-81, crude ash MSZ 6830/3-85, starch MSZ 6830/18-79.

RESULTS

Without foliar fertilization the yield of the examined hybrid was ranging between 9.9-11.8 t/ha. In control plots the yield fluctuation was 1.9 t/ha. With foliar fertilization the yield was 10.3-11.47 t/ha. Under the influence of foliar fertilization treatments the yield fluctuation was lower 1.17 t/ha (*Table 2*).

Table 2. The effect of foliar fertilization on the yield of maize hybrid (t/ha)

	1. repl.	2. repl.	3. repl.	yield (average repl.)	yield fluctuation
control	11.80	11.07	9.9	10.92	1.90
foliar fertilization	11.47	10.45	10.3	10.74	1.17
LSD 5%				1.31	

The yield of the control plots/treatments in the average of three replications was 10.92 t/ha. Under the influence of foliar fertilization the yield was 10.74 t/ha. There is no significant difference between the yields (LSD 5 %= 1.31 t/ha). The foliar fertilization does not decrease the yield of maize. It is necessary to continue the experiment to explore the exact reasons because the results of at least three years are needed to draw the correct conclusions about the continuation of the experiment.

We examined the effect of foliar fertilization on the chemical composition and nutritive value of maize seeds. The results of chemical analyses see table 3. We compared the results of untreated control with treated ones with statistical analyses as well. The dry matter content was 880 g/kg of control and 879 g/kg almost the same. The crude protein content increased in treated maize with 3.3 gram for 78.3 g/kg. Also increased the crude fat content with 7 g/kg for 45 g/kg which was significant on LSD 5% level. There was no considerable different in crude fiber content. It was 44.3 g/kg of control, and 44.6 g/kg of treated seeds. The crude ash was 1 g less in treated seeds (it was 13.3 g/kg and 12.3 g/kg respectively).

Unfortunately the most important component of maize the starch content decreased with 61.3 g/kg in the treated maize. While the control contained 605.6 g/kg starch, the treated had 544.3 g/kg only. It resulted 10.1% decreasing, which was no significant. With the consequence of this reduction of starch the N-free extract content was also less in the treated maize. While the control contained 709.3 g/kg N-free extract, the treated one contained 11.3 g/kg less (698 g/kg) which means 1.6% reduction which was significant on LSD 5% level. The energie content was related to the pig diger energy (DE) and metabolisable energy (ME). The results showed that there was no considerable differences in the energy contents of control and treated maize. The DE was 14.20 MJ/kg of control, and 14.23 MJ/kg of treated seeds. The ME was 13.93 MJ/kg and 13.95 MJ/kg respectively.

Table 3.

The results of chemical analyses of maize seeds

Name		**control**	**treated**	**LSD 5%**
Dry matter (DM)	g/kg	879.6	879	n.s.
Crude protein (CP)	g/kg	75	78.3	n.s.
Crude fat (CFat)	g/kg	38	45	4.3
Crude fiber (CF)	g/kg	44.3	44.6	n.s.
Crude ash (CA)	g/kg	13.3	12.3	n.s.
N-free extact	g/kg	709.3	698	10.33
Starch	g/kg	605.6	544.3	n.s.
Pig				
Diger energy (DE)	MJ/kg	14.2	14.23	n.s.
Metabolisable energie (ME)	MJ/kg	13.93	13.95	n.s.

CONCLUSIONS

We can conclude, that on the contrary of changing in chemical component of control and treated maize it did not results important difference of nutrient value of the applied dosage of foliar fertilizer.

The foliar fertilisation of corn is currently not part of the production technology. As KÁDÁR (2008) emphasized, the future spread of foliar fertilization should be grounded by a comprehensive experimental research. Accurate, repeat small plot trials are necessary to clarify the factors influencing the effectiveness of foliar fertilizers and to develop proposals for consultancy. The present experiment and its continuation also serve this purpose.

REFERENCES

1. **BERZSENYI Z.,** 1993: Effect of N-fertilization and year on the grain-yield and N-fertilizer-reaction in maize hybrids (*Zea mays* L.) in long-term trial in 1970-1991. Növénytermelés. Tom. 42. No. 1. 49-62.p.
2. **DOBOS A., NAGY J.,** 1998: Effect of year and fertilisation on the dry matter production of maize (*Zea mays* L.). Növénytermelés. Tom 47. No.5. 513-524.p.
3. **KÁDÁR I.**, 2008: A levéltrágyázás jelentősége és szerepe a növénytáplálásban. Acta Agronomica Óváriensis. Vol. 50. No.1. 19-27.p.
4. **NAGY J.**, 1995: Evaluation of fertilization effect on the yield of maize (*Zea mays* L) in different years. Növénytermelés. Tom. 44. No. 5-6. 493-506.p.
5. **SÁRVÁRI M.,** 1995: The productivity and fertilizer reaction of maize hybrids on meadow soil. Növénytermelés. Tom. 44. No.2. 179-191.p.
6. **SVÁB, J.**, 1981: Biometriai módszerek a kutatásban. Mezőgazdasági Kiadó. Budapest. 557.p.