EFFECT OF NUTRIMENT ELEMENTS (NPK) TO THE CROP OF MAIZE (ZEA MAYS L.) IN THE YEAR OF 2016-2017

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Abstract. *The world's and the domestic maize growing technological development depends on the applied agricultural engineering largely. The most important thing the harmonic NPK nutrition solution to the crop increase and the reduction of the crop fluctuation. During our research we examined the different nutriment elements, and their proportions in monoculture long-term experiment of maize. The experiment was set up in Hungary at Szarvas in the experimental field of the University of Szent István, Faculty of Agricultural and Economics Studies, in Galambos. We reveal the plant physiology and technological contexts in our examinations, that the bases of the modern nutrient solutions, and the scientific bases of the efficient development of the maize growing system. We examined 64 nutrient combination in the experiment, 4 nitrogens portion (0 kg ha-1, 70 kg ha-1, 140 kgha-1 and 210 kgha-1), 4 phosphoruses portion (0 kg ha-1, 40 kgha-1, 80 kgha-1 and 120 kgha-1) and 4 potassiums portion (0 kg ha-1, 60 kg ha-1, 120 kg ha-1 and 180 kgha-1) in different combinations. On the parcels all possible combinations get to a setting, which makes the examinations of the interaction of the nutriment elements.*
The setting of the experiment onto the bases of the old fertiliser experiment of Faculty on a similar manner, on similar principles, modernized to the scientific and practical claims of our days. We established that the role of the phosphorus and the potassium are smaller in the experiment, they affect the physiological processes of the maize advantageously mostly. The effect has on the average yield is smaller because it is based on the interaction of the different nutriment elements. The analysis of variance of the yields supported this, we experienced that the effect of nitrogen has the most significant difference. In our experiment the largest effect from among the examined three nutriment elements the nitrogen showed it, we experienced a smaller effect in case of the phosphorus and the potassium. From among the examined parameters significant differences only the nitrogen treatments could to justify, the effects the phosphorus and the potassium mostly trend character, the border of the significance was attained in a little proportion only. In the experiment the average yields were between 3,65 t ha-1 and 13,9 t ha-1.

Keywords: *maize, nutrient supply, nitrogen, phosphorus, potassium*

INTRODUCTION

In recent years, maize was the world's second largest field crop after wheat. Its output is based on FAO data on an annual basis of 939 million tonnes in 2014 and is projected to increase this figure by an average 12 million tonnes per year. In Hungary corn is one of the largest field crops. 26-27% of all arable land. Its main field of use is animal feed, which is about 90% of the yield in our country. According to research and forecasts, over the next 50 years the Earth's population will exceed 9-10 billion. With the ever-increasing population of the world's population, food use is also becoming increasingly important.

Technological development of world and domestic maize production, besides many other processes, depends to a great extent on the applied agrotechnics. The most important is the development of yield increase and the reduction of crop fluctuation, in which the harmonious NPK nutrition supply also plays an important role The yield of corn may be influenced by many factors such as water- and nutrient deficiency, etc. All these factors have effects on the leaf area of corn, which is the most important scene of photosynthesis. If there are any opportunities to increase the photosynthetically active leaf area, it could have a very favourable effect on the potential yield. One opportunity for increasing the photosynthetically active leaf area is giving the plant an increasing nutrient supply. (FUTÓ, 2003).

BERZSENYI (1993) studied the dynamics of growth and growth characteristics of maize (Zea mays L.) a long-term trial in 1961. The N treatments were as follows: 0, 80, 160, 240 kg ha^{-1}. The dynamics of growth of leaf area reliably reflect the effect of N deficiency and N fertilization, respectively, on growth. The yield(max) and LAI(max) and cumulated values of LAD were highest in N160 and N240 treatments.

With increasing fertilization, the assimilation surface and lifespan of the plant increase at different levels for the different hybrids, so more radiation energy is absorbed by the plant which results in a yield increment. We found a very tight positive correlation between the leaf area index of the hybrids and their yields. The natural nutrient utilization of maize hybrids and their fertilizer response vary greatly, which should be taken into consideration at fertilization and in the fertilization technology. EL HALLOF N. (2008)

Taking into consideration the forecrop, the year effect, the nutrient supply and effectiveness and environmental protection, the N40-120, P2O5 25-75 and K2O 30-90 kg/ha active nutrient doses are satisfactory for corn hybrids. JAKAB P. (2003)

MATERIAL AND METHODS

In the course of our research we studied various nutrients (N, P, K) and their different proportions in maize monocultures. The experiment was carried out for two years, in a small parcel, three-repetition, two-part parcel layout in Hungary, in Szarvas, at the Galambos experimental site of the Agricultural and Economics Faculty of Szent István University. During our studies, we explore the plant physiologies and technological relationships that can serve as a basis for modern nutrient management and provide scientific basis for the effective development of maize production. In the experiment we examined the effect of three nutrients N, P and K, where the nutrients were released in three ascending stages. Nutrients, however, were not only tested on their own but in as many combinations as possible, so we can track the effect of each nutrient on each other.

Levels of nitrogen treatments:

N0 0 kgha-1 N as basic fertilizer, 0 kg ha-1 N as top-dressing
N1 50 kg ha-1 N as basic fertilizer 20 kg ha-1 N as top-dressing
N2 100 kg ha-1 N as basic fertilizer 40 kg ha-1 N as top-dressingt
N3 150 kg ha-1 N as basic fertilizer 60 kg ha-1 N as top-dressing

Levels of phosphorus treatments:

P0 0 kg ha-1 P as basic fertilizer
P1 40 kg ha-1 P as basic fertilizer
P2 80 kg ha-1 P as basic fertilizer
P3 120 kg ha-1 P as basic fertilizer

Levels of potassium treatments:

K0 0 kg ha-1 K as basic fertilizer
K1 60 kg ha-1 P as basic fertilizer
K2 120 kg ha-1 P as basic fertilizer
K3 180 kg ha-1 P as basic fertilizer

The experimental parcels size 4m x 5m. The 5 m long parcel width allows you to place 6 rows each with a 76 cm row spacing. Sowing was carried out with a pneumatic grain seed drill for the whole experimental area. After rising, we have paved roads with rotary cultivator to form the parcels. The seed distance was determined at 17.8 cm, which is approximately 75000 seeds per hectare. 2 of the 6 rows can be considered as a border line, avoiding any fertilizer overlapping between parcels. The samples was required for the tests" got from lines 2 and 5, the harvest and the other measurements were performed on the two middle rows. Harvesting was done manually

According to previous soil surveys, the soil of the experimental area is deeply carbonated chernozem soil. The main characteristics of the soil of the experiment can be summarized as follows from the soil tests performed (Table 1)

Table 1.

Characteristics of the soil experiment (Szarvas, 0-30 cm soil layer) Source: Author 's own editing

pH (KCl)	K_A	$CaCO_3$	Humus (%)	AL-P_2O_5 $mgkg^{-1}$	AL-K_2O $mgkg^{-1}$	Mg (KCl) $mgkg^{-1}$	EDTA-Zn $mgkg^{-1}$	EDTA-Cu $mgkg^{-1}$	EDTA-Mn $mgkg^{-1}$
4,91	43,6	0,0	2,94	211	255	697	3,16	7,41	437

In the year 2016 rainfall between January and September was 38.6 mm above the multi-annual average. The precipitation of the month of September fell by 33 mm below the 30-year average, which contributed water yields of large crops and to ripening

Table 2.

Data of weather between jan. of 2016. and sept. of 2016. Szarvas ,Source: Author 's own editing

Month (1)	**jan.**	**febr.**	**march.**	**apr.**	**may.**	**jun.**	**jul.**	**aug.**	**sept.**	**sum / average**
Temperature(°C) (2)	-0,9	6,0	7,3	13,4	16,6	21,3	22,5	21,1	18,3	13,9
Rain (mm) (3)	61,6	88,5	20,0	12,3	18,8	124,4	124,4	50,5	9,8	448,7
Mean of rainfall of 30 years (mm) (4)	30,6	31,4	28,9	41,9	62,9	71,4	74,4	56,4	42,8	410,1
Difference (mm) (5)	**31,0**	**57,1**	**-8,9**	**-29,6**	**-44,1**	**53,0**	**50**	**-5,9**	**-33,0**	**38,6**

In the year 2017, the precipitation rainfall between January and September was 39 mm lower than the multiannual average. The April rainfall was 33 mm higher than the 30-year average. This help rising and initial development of maize, but the surplus rainfall of 31.4 mm in September was hampered by the drying required for harvesting

Table 3.

Data of weather between jan. of 2016. and sept. of 2017. Szarvas Source: Author 's own editing

Month (1)	**jan.**	**febr.**	**march.**	**apr.**	**may.**	**jun.**	**jul.**	**aug.**	**sept.**	**sum / average**
Temperature(°C) (2)	-6,7	2,6	9,4	11	17,2	22	22,8	23,7	16,6	13,2
Rain (mm) (3)	28,3	30,2	13,4	49,7	40,9	69,3	31,8	33,3	74,2	371,1
Mean of rainfall of 30 years (mm) (4)	30,6	31,4	28,9	41,9	62,9	71,4	74,4	56,4	42,8	410,1
Difference (mm) (5)	**-2,3**	**-1,2**	**-15,5**	**7,8**	**-22**	**-2,1**	**-42,6**	**-23,1**	**31,4**	**-39**

RESULTS AND DISCUSSION

After the manually harvest, crushing and processing the experiment the yield averages measured at different nutrient levels were obtained. The results for the years 2016 and 2017 are shown in Figure 1-3.

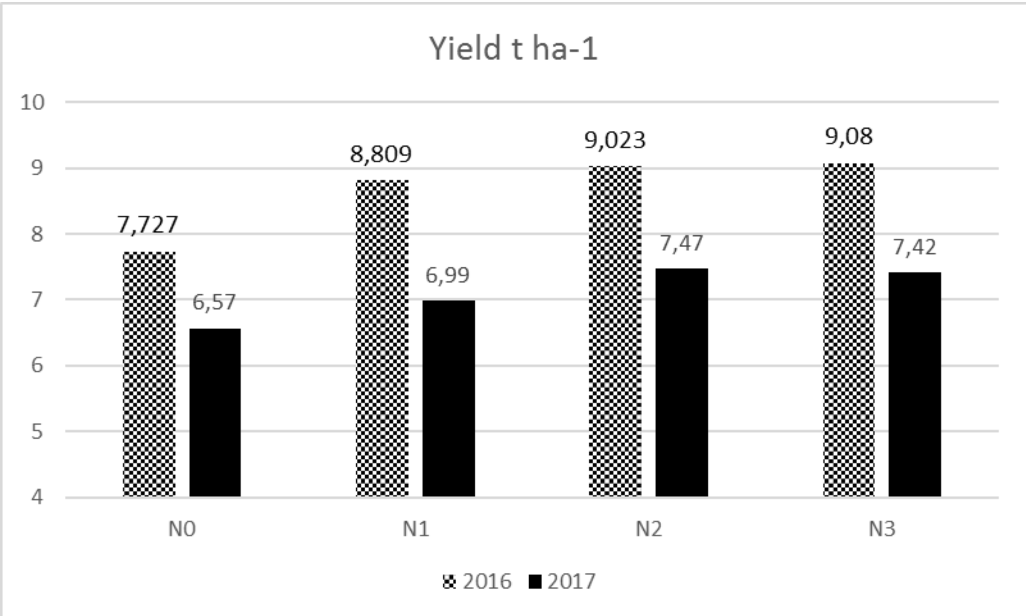

Figure 1: Change of yield of maize (t ha-1) in different nitrogen level in 2016-2017
Source: Author 's own editing

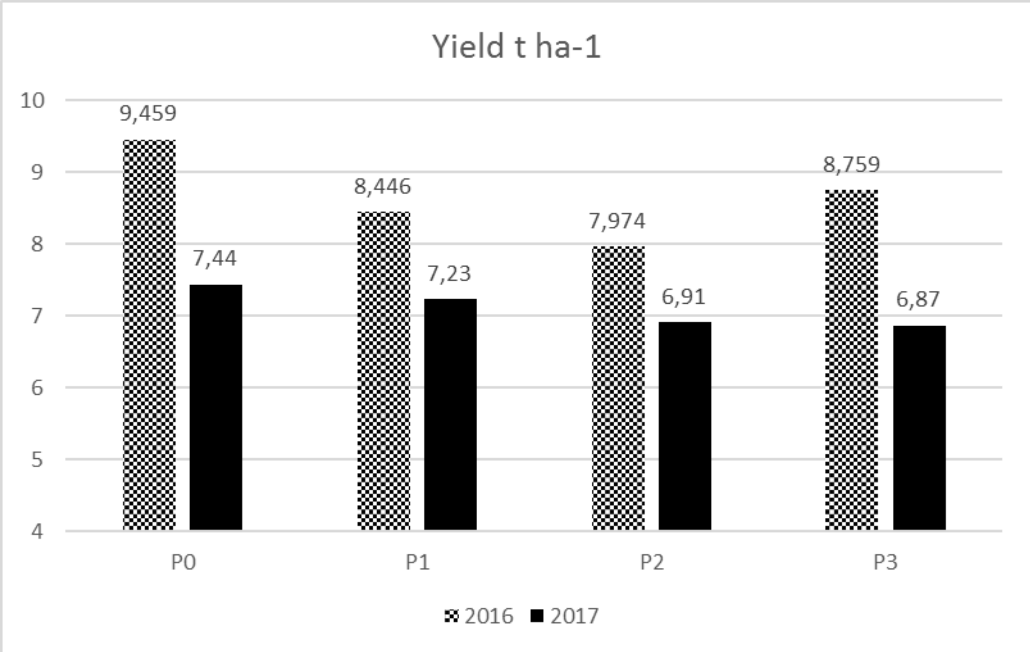

Figure 2: Change of yield of maize (t ha-1) in different phosphorus level in 2016-2017
Source: Author 's own editing

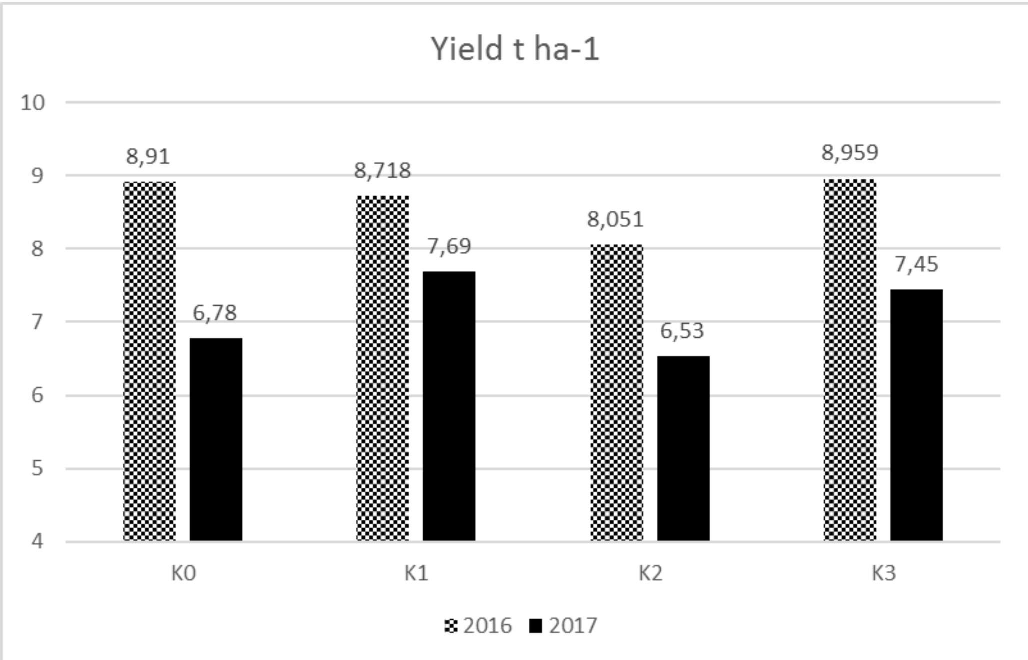

Figure 3: Change of yield of maize (t ha-1) in different potassium level in 2016-2017
Source: Author 's own editing

In the two years examined the variance analysis of the yields measured on the nutrient levels was followed up to see if the change achieved reaches the level of significant difference. The variance values are given in 4-5 Table shows

Table 4.

Table of variance analysis of yield 2016

Dependent Variable: Yield

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	138,733[a]	9	15,415	3,475	,001
Intercept	14397,596	1	14397,596	3245,843	,000
Nitrogen	57,656	3	19,219	4,333	**,006**
Phosphorus	55,851	3	18,617	4,197	**,007**
Potassium	25,226	3	8,409	1,896	**,132**
Error	807,298	182	4,436		
Total	15343,628	192			
Corrected Total	946,031	191			

Table 5.

Table of variance analysis of yield 2017

Dependent Variable: Yield

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	79,781[a]	9	8,865	2,920	,003
Intercept	9722,932	1	9722,932	3202,189	,000
Nitrogen	25,662	3	8,554	2,817	**,040**
Phosphorus	10,764	3	3,588	1,182	**,318**
Potassium	43,356	3	14,452	4,760	**,003**
Error	552,614	182	3,036		
Total	10355,328	192			
Corrected Total	632,395	191			

Based on the variance analysis, the difference in the yields of both years was significant only to the N levels. Growth of P and K levels was only significant in only one years, and the effects were trendly.The role of phosphorus and potassium is smaller in the yield of maize, they mostly affect the physiological processes of maize favorably. The effect on yield is smaller because it is based on the interaction of the different

When analyzing the yield with regression analysis, we found that the values are most linearly altered. Increasing levels of nitrogen produced a clear yield increase, proving that the correlation between the supply of nitrogen in corn and corn yields is very close.

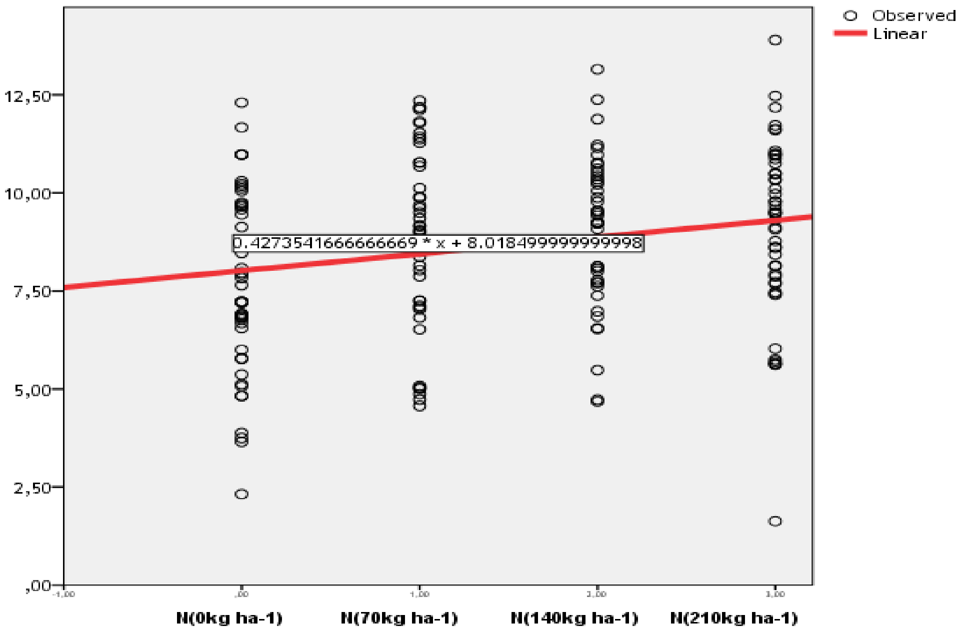

Figure 4. Linear regression of maize's yield and N levels. 2016

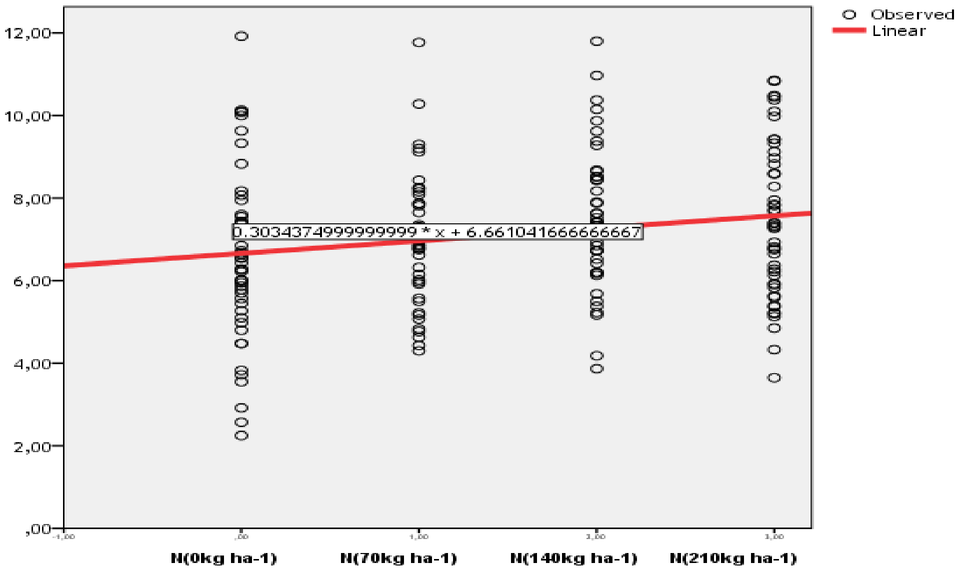

Figure 5. Linear regression of maize's yield and N levels 2017.

CONCLUSIONS

In our experiment, the nutritional reactions of monocultured maize were examined for the changes in crop yields We found that the greatest effect of our experiment was shown by nitrogen among the three nutrients, and a lower effect was by phosphorus and potassium. Significant differences between the examined parameters were found in most cases only in the case of nitrogen treatments, and in the case of phosphorus and potassium the effects are most trendy.We have proved that the increasing nitrogen content results in the formation of higher average yields, the correlation shows a close positive correlation, and the regression analysis has supported our initial hypothesis.

ACKNOWLEDGMENTS

The publication was created with the support of the project EFOP-3.6.1-16-2016-00016.

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