

# FERTILIZATION EFFECT ON THE NUTRIENT AND WATER UTILIZATION OF DIFFERENT GENOTYPES HYBRIDS

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**Abstract:** The experiment was set up on chernozem soil at the Látókép Experimental Station of the University of Debrecen in Hungary. We measured the yield, the yield production per 1 kg NPK fertilizer and the water and nutrient utilization of hybrid P9578, P9494 and SY Afinity in 2013. We have found that out of the maize hybrids in the experiment, the yield of the hybrid P9578 varied between 11428 kg ha<sup>-1</sup> and 16838 kg ha<sup>-1</sup>, P9494 hybrid was between 11293 kg ha<sup>-1</sup> and 17132 kg ha<sup>-1</sup>, while SY Afinity produced yield in the range between 14550 kg ha<sup>-1</sup> and 18619 kg ha<sup>-1</sup>. The yield per 1 kg NPK fertilizer, the highest yield increase we found at the level of N<sub>30</sub>+PK, compared to control treatment. The hybrid P9578 yield of 54.2 kg kg<sup>-1</sup>, and of hybrid P9494 of 39.2 kg kg<sup>-1</sup> plus of hybrid SY Afinity, 25.6 kg kg<sup>-1</sup> increase was measured in the mentioned nutrient treatments. The water utilization of the hybrids the worst was of the control treatment (P9578: 41.9 kg mm<sup>-1</sup>, P9494: 41.4 kg mm<sup>-1</sup>, SY Afinity: 53.3 kg mm<sup>-1</sup>). The best water utilization was experienced in the N<sub>120</sub>+PK nutrient treatment (P9578: 61.7 kg mm<sup>-1</sup>, P9494: 62.8 kg mm<sup>-1</sup>, SY Afinity: 68.2 kg mm<sup>-1</sup>). The best nutrient utilization performed by the hybrid SY Afinity, while the weakest one was done by the hybrid P9494.

**Keywords:** maize, hybrids, yield, water-utilization, fertilization

## Introduction

Precipitation during autumn – winter months and the rainfall quantity and its distribution in vegetation period have very important impact on the yield of maize. Dóka (2013) had similar results according to his experimental results. Several researches (i. e. Moser et al., 2006) stated that water and nitrogen supply were key elements in maize production. One of the most important agrotechnical factors of the yield increase of maize is nitrogen fertilization on brown forest soil (Berzsenyi et al., 2009). Berzsenyi and Lap (2009) proved that nitrogen utilization of various maize genotypes (hybrids, inbred strains) is different. Pepó, (2009) concluded that water utilization determined the yield enhancing effects of fertilizers. This was altered by crop rotation and irrigation. Considering effects and utilization of fertilizers, water utilization has to be taken into account (Pummer, 1995). According to their results, the grain yield of maize increased gradually up to the nutrient level of N<sub>160</sub>. According to the experimental results of Rácz and Nagy (2011), on chernozem soils of medium-good NPK supply, the nutrient doses above 120 kg ha<sup>-1</sup> N didn't increase the yield in economical extent. In fact, in dry weather year, N dose above 120 kg ha<sup>-1</sup> decreased maize yields directly.

## Materials and methods

The soil of the experimental area is chernozem with lime patches at the Látókép Experimental Station of the University of Debrecen. The area is located in Eastern-Hungary on aeolian loess parent material of the Hajdúság geographical region. Tilt of the area is around 80 to 90 cm, its agricultural condition is good, texture is medium

hard and loamy with humus content of 2.6 – 2.8%. Features of water supply of the soil are favorable. The long-term experiment was set up in 1983. We have investigated the P9578 (FAO 320), P9494 (FAO 390) and SY Afinity (FAO 470) maize hybrids in a small-plot experiment in 2013. The crop rotation of our long-term experiment was wheat-sunflower-wheat-maize. The fertilization covered six levels of treatments. The basic mineral fertilizer dosage was 30 kg ha<sup>-1</sup> nitrogen, 22.5 kg ha<sup>-1</sup> phosphorus and 26.5 kg ha<sup>-1</sup> potassium active substance. The other treatments were two-, three-, four- and five-times dosages of it. 50% of the nitrogen and 100% of phosphorus and potassium were applied in the autumn. 50% of nitrogen was applied before planting time of maize. The experimental data were analyzed by SPSS for Windows 13.0 statistical programme.

Table 1: The main weather parameters during the vegetation period of maize (Debrecen, 2013)

Precipitation (mm)	October-March	April	May	June	July	August	September	Total
2012-2013	332,7	48,0	68,7	30,8	15,6	32,2	47,6	575,6
30 year's average	220,2	42,4	58,8	79,5	65,7	60,7	38,0	565,3
Temperature (°C)	October-March	April	May	June	July	August	September	Average
2012-2013	3,6	12,0	16,6	19,6	21,2	21,5	14,0	15,5
30 year's average	2,9	10,7	15,8	18,7	20,3	19,6	15,8	14,8

## Results and discussion

We investigated the yield of maize hybrids. We found that the yield of the P9578 hybrid was between 11.428 kg ha<sup>-1</sup> and 16.838 kg ha<sup>-1</sup>, P9494 hybrid is yield between 11.293 kg ha<sup>-1</sup> and 17.132 kg ha<sup>-1</sup>, while the yield of the hybrid SY Afinity was between 14.550 kg ha<sup>-1</sup> and 18.619 kg ha<sup>-1</sup> respectively. The optimum of the three hybrids was N<sub>120</sub>+PK and these hybrids gave the maximum yield in this treatment.

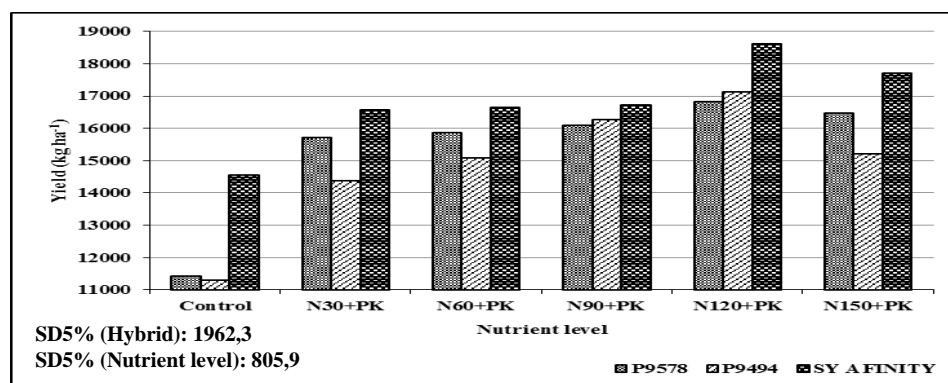


Figure 1: The average yield of the hybrids on the different nutrient levels (Debrecen, 2013)

The fertilization response of maize hybrids represents the yield kg 1 kg NPK<sup>-1</sup> parameter. We proved that the hybrids performed the highest yield increases at the nutrient level of N<sub>30</sub>+PK, compared to the control. P9578 hybrid gave 54.2 kg yield increase per 1 kg NPK, while in cases of the hybrids P9494 and SY Afinity, these were 39.2 and 25.6 kg, respectively. In the fertilizer treatment of N<sub>150</sub>+PK, we observed yield decrease compared to the nutrient level of N<sub>120</sub>+PK.

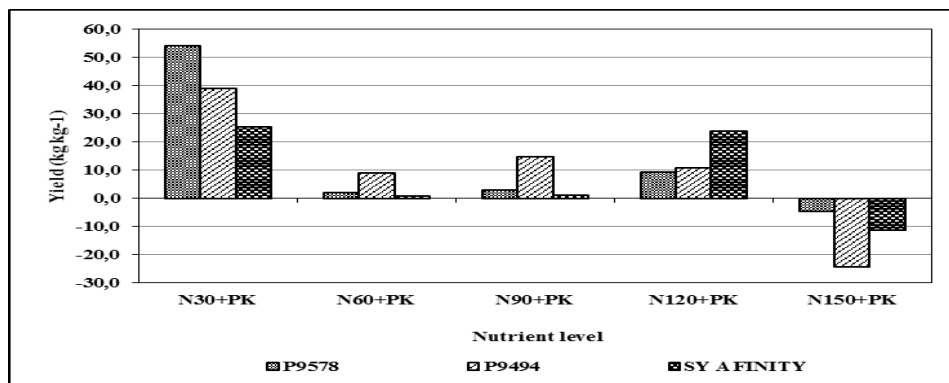


Figure 2. Development of the yield growth per each kg applied NPK fertilizer active substance (Debrecen, 2013)

Both nutrient and water utilization are important for scientific and practical purposes. We calculated water use efficiency (WUE) which means the yield kg 1 mm<sup>-1</sup> rainfall in the vegetation period (April – September). In control treatment the WUE values of hybrids varied between 41.4 and 53.3 kg per 1 mm precipitation. The best water utilizations were observed on the nutrient level of N<sub>120</sub>+PK. The values were as follows: 61.7 kg mm<sup>-1</sup> for P9578, 62.8 kg mm<sup>-1</sup> for P9494, while 68.2 kg mm<sup>-1</sup> for SY Afinity, respectively.

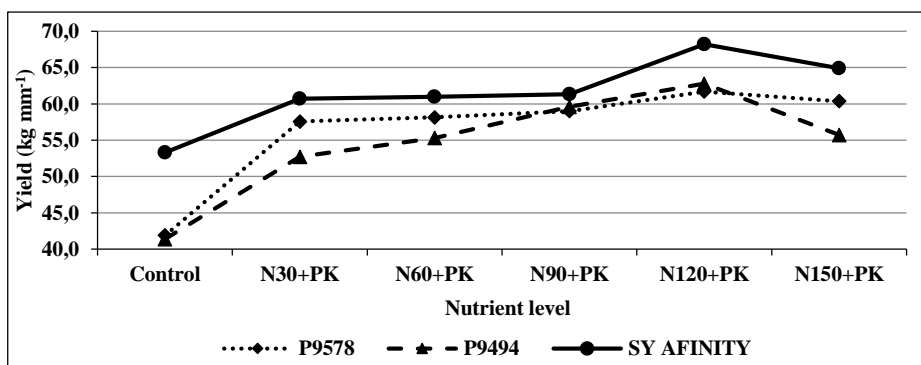


Figure 3: The water-utilization of the different maize hybrids on the different nutrient-levels (Debrecen, 2013)

## Conclusions

Our scientific results proved that the highest yields were performed by the maize hybrids in the nutrient treatment of N<sub>120</sub>+PK. Analyzing the yields per 1 kg NPK fertilizer, we found the highest yield increases in N<sub>30</sub>+PK nutrient treatments, compared to the control (P9578: 54.2 kg kg<sup>-1</sup>, P9494: 39.2 kg kg<sup>-1</sup>, SY Afinity: 25.6 kg kg<sup>-1</sup> respectively). The worst water utilizations (WUE) were obtained in the control treatment (P9578: 41.9 kg mm<sup>-1</sup>, P9494: 41.4 kg mm<sup>-1</sup> and SY Afinity: 53.3 kg mm<sup>-1</sup> respectively), while the best one in the nutrient treatment of N<sub>120</sub>+PK (P9578: 61.7 kg mm<sup>-1</sup>, P9494: 62.8 kg mm<sup>-1</sup> and SY Afinity: 68.2 kg mm<sup>-1</sup> respectively).

## Acknowledgements

This research was supported by the European Union and the State of Hungary, co-financed by the European Social Fund in the framework of TÁMOP-4.2.4.A/2-11/1-2012-0001 'National Excellence Program'.

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