

## THE EFFECT OF ARTIFICIAL FERTILIZERS ON THE PHOTOSYNTHETIC ACTIVITY OF MAIZE HYBRIDS

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### Introduction

Maize (*Zea mays L.*) is one of our major crops presently. In the future, we can only achieve better results in production, if energy-saving, environmentally-benign technologies are applied.

The agro-ecological, biological-genetical control, the adaptation of cultivars, the determination of optimal yield levels, the exploration of positive interactions between the biological-agrotechnical factors, the complex study of interactions and the development of simulation models are important tasks.

The precondition of increasing yields is the widening of biological bases: the breeding and fast spreading of high-yielding hybrids with good characteristics.

### Literature review

Grain yield genetically correlates with total leaf area and its spatial arrangement (Jakuson 1973; Palmer et al., 1973). Leaf area and photosynthetic activity are the major factors determining grain yield (Piorel-Russel, 1974). There is a tight correlation between biomass and leaf area (Précsényi et al., 1976, 1977; Bálint, 1977; Menyhárt et al., 1980). However, leaf surface is a considerable evaporation surface at the same time. Duncan et al (1984.) have stated that if the distribution of sunlight was more even due to a change in the position of leaves, then yield would increase to a higher level with the increase of LAI, e.g. if the leaves were more vertically oriented. Increasing plant density is a method for increasing the radiation absorption of leaves, however, the too high plant density inhibits the transformation of light energy into grain crop via infertility (Stinson és Moss 1960, Willey et al 1967). The different fertilization levels caused a significant difference in the photosynthetic activity, the highest photosynthetic activity in the average of the three measurement dates was measured at 120 kg ha<sup>-1</sup> N+PK dosage (Csajbók – Kutassy 2001). There is a certain correlation between the photosynthetic activity and the yield of maize hybrids (Zsoldos 2002).

### Materials and Methods

We have studied the yield, the individual leaf area (LA) and the leaf area index (LAI) of maize hybrids, the effect of cultivar and fertilization on the growth dynamics of total leaf area and the effect of fertilization and climatic factors on the photosynthetic activity of the different hybrids.

The table 1, 2 and 3 contains the datas of wheather.

Table 1: The amount of precipitation in 1999

	Average of 50 years (mm)	Precipitation (mm) in 1999
<b>Total:</b>	<b>583</b>	<b>666</b>
<b>Difference from the average</b>		<b>83</b>
<b>Vegetation period IV-IX.</b>	<b>340</b>	<b>382</b>
<b>Difference:</b>		<b>42</b>

Table 2: Temperature data in 1999

	T (°C) 1999	Average of 50 years (°C)	Difference in 1999
<b>Annual mean T (°C)</b>	<b>10.80</b>	<b>9.98</b>	<b>0.82</b>
<b>Mean of the IV-IX. period T (°C)</b>	<b>18.25</b>	<b>17.20</b>	<b>1.05</b>

Table 3: The number of sunny hours in 1999

	1999	Average of 50 years	Difference in 1999
<b>Total:</b>	<b>2089.00</b>	<b>2119.00</b>	<b>-30.00</b>
<b>In the vegetation period:</b>	<b>1499.70</b>	<b>1551.00</b>	<b>-51.30</b>

#### Soil characteristics:

The experiment was carried out on calcareous chernozem soil that was easily cultivable. The  $\text{CaCO}_3$  content was leached to the lower layers by precipitation and leaching was characteristic to the topsoil.

*Applied fertilizer dosages (active ingredient, 1999)* In the control, no fertilization was performed, the basic treatment was  $\text{N } 40$ ,  $\text{P}_2\text{O}_5 \text{ } 25$ ,  $\text{K}_2\text{O } 30 \text{ kg ha}^{-1}$ , the highest dosage was five times that of the basic treatment.

Photosynthesis was measured with a portable LI 6400 photosynthesis measuring device on 20 June, 15 July and 15 August. The individual leaf area was measured four times during the vegetation period on the hybrids Monessa, Mv Norma, Dk 527 and Florencia.

#### Results and Discussion

An increase in the LAI index was measured during the vegetation period. It can be stated that the early-maturing hybrids have a lower leaf area index than the late-maturing hybrids. In the beginning of the vegetation period, we detected a great increase in LAI by applying 40, 25 and 30  $\text{kg ha}^{-1}$  dosages of N, P and K, respectively. When the active ingredient dosage was further increased, no or a small increase was detected in the leaf area.

The correlation between fertilizer dosage and LAI value can be modified by changes in the nutrient supply of the soil, the dynamics of the nutrient supplying capacity and the physical-chemical characteristics and by the intensity of the hybrid and the technology.

Leaf area has been known to have a great impact on the photosynthetic activity of plants, which influences the yield of maize hybrids.

The impact of fertilization and the climatic factors on the photosynthetic activity of hybrids with different genetic characteristics: Among the four hybrids, Monessa had the highest photosynthetic activity. With the increase of the fertilizer dosage, the photosynthetic activity of the hybrids with different maturing time and genetic characteristics also increased gradually. With the advancing of the vegetation period, the photosynthetic activity gradually

decreased, since the active leaf area was reduced due to the drying of the plant. Analysis of variance showed that the hybrid and the fertilizer had a significant individual and combined effect on the photosynthetic activity and consequently on the yield of maize hybrids.

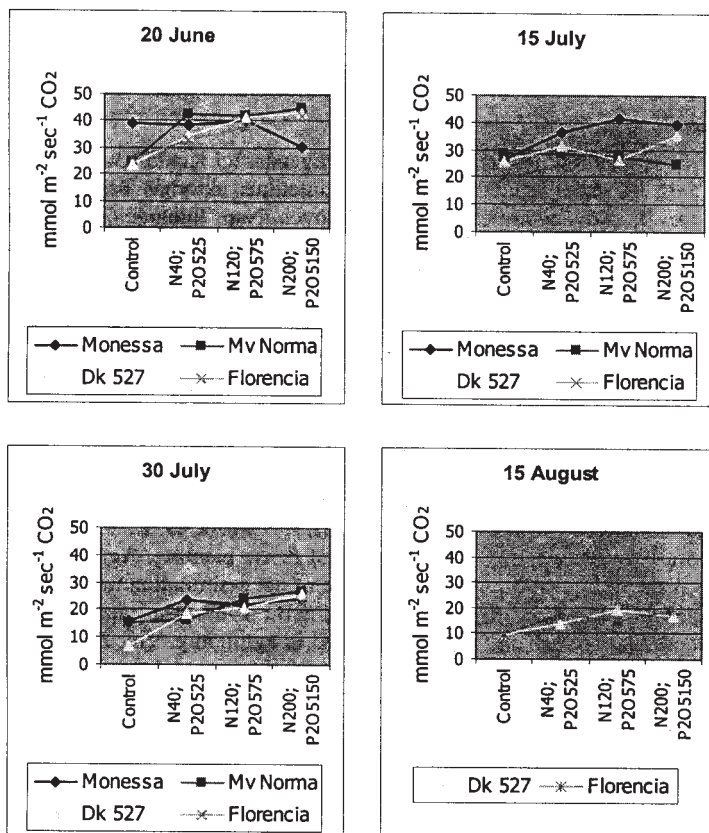


Figure 1: The photosynthetic activity of hybrids with different genotypes in relation to maturing time and fertilization, 1999

### Summary

The year effect greatly determines also the efficacy of the NPK fertilizers besides yields. Depending on the hybrid and the year, an economical and reliable yield increment was achieved by applying lower fertilizer doses. The higher fertilizer doses did not result in a reliable yield increment compared to lower doses.

The most advantageous and most effective NPK treatment was when N 40-120, P2O<sub>5</sub> 25-75, K<sub>2</sub>O 30-90 kg ha<sup>-1</sup> active ingredient dosages were applied.

The hybrid and the fertilizer had a significant individual and combined effect on the photosynthetic activity and consequently on the yield of maize hybrids

The LAI values have varied greatly depending on the hybrid and the year. The LAI value of early hybrids ranged between 2-4 m<sup>2</sup> m<sup>-2</sup>, while that of the medium and medium-late maturing hybrids almost reached 5 m<sup>2</sup> m<sup>-2</sup>. LAI values of the hybrids varied in the different fertilizer treatments and during the vegetation period. There was a tight correlation between LAI and

yield. The different hybrids had a different photosynthetic activity, which was influenced by the fertilizer treatments. For most hybrids, the highest activity was measured in the treatment with the highest (N 200+PK) dosage. Photosynthetic activity also correlated with yield to a varying extent up to the treatment with N 120, P<sub>2</sub>O<sub>5</sub> 75, K<sub>2</sub>O 90 kg ha<sup>-1</sup>. The maximum yield of hybrids in the experimental year was 8.44 t ha<sup>-1</sup>, 9.97 t ha<sup>-1</sup>, 10.86 t ha<sup>-1</sup> and 11.24 t ha<sup>-1</sup> for Monessa (FAO 200), Norma (FAO 380), DK 527 (FAO 490), and Florencia (FAO 530), respectively.

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