The main influencing factors effecting the yield of maize

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SUMMARY

Maize is one of Hungary's major cereals. In the 1970s and 1980s, we were in the frontline regarding yields and genetic advancement. However, yield fluctuation in maize has increased to 50-60% from 10-20% since the 1980s, which was partly caused by the increase in weather extremes due to climate change and by agrotechnical shortcomings.

The experiments were carried out on typical meadow soil in four repetitions in the period of 2007-2008. In the sowing time experiment, sowing was performed on 10 April, 25 April, 15 May under a uniform fertilization of N120, $P_2O_5$80 K_2O 110 kg/ha. In the fertilization experiment, the yielding capacity of 10 hybrids with different genetic characteristics was studied in a control (non-fertilized) treatment and basic treatment of N40 P_2O_5 25, K_2O 30 kg ha^{-1} active ingredient and a treatment with fivefold dosages of the basic treatment. In the plant density experiment, the relationship between plant density and yield was analysed at plant densities of 45, 60 and 75 thousand plants per ha.

We found a tight correlation between sowing time and yield and grain moisture content at harvest. We found that grain moisture can be reduced by 5-10% by applying an earlier sowing time.

The agroecological optimum fertilizer dosage was N 40-120, P_2O_5 25-75, K_2O 30-90 kg ha^{-1} active ingredient at a plant density of 60-90 thousand plants ha^{-1} depending on the hybrid and the year.

INTRODUCTION

According to Berzsenyi and Győrffy (1997), the aim of crop production has been the maximalization of growth rate and plant biomass production for several decades.

N supply has the greatest influence on the amount of yield, Bocz (1976). The N content of soils is an important factor in soil fertility (Nyíri, (1993). However, excess N results in yield reduction and harmful nitrogen accumulation (Németh and Kádár, 1999). According to the results of Nagy (1997), the natural nutrient exploration ability should be taken into consideration besides the fertilizer response. Fertilization has a significant effect on the ratio of grain and other plant parts (Nagy, 1978).

Results from 3 years experiments confirm an important influence of foliar fertilizers in combination with heavy fertilization (B2 3 resp. C2, 3) for high yield grain of maize (Szűcs and Molnárová, 2008).

For environmental considerations, it is important to adjust the fertilization to the requirements of the crop, to the dynamics of nutrient uptake and the growing site conditions (Várallyay and Németh, 1996; Németh, 2001).

With an early sowing time, the grain moisture content at harvest can be considerably reduced (Árendás, 2000). Very early and early hybrids have a wider optimal sowing time interval than hybrids with longer vegetation periods (Sárvári, 2005).

The optimum plant density of maize hybrids depends not only on the length of the variety's vegetation period but also on the genotype (Nagy, 2000). According to Pepó et al. (2002), the efficacy of maize production can only be improved via a hybrid-specific plant density adapted to the growing site and the agronomical conditions.

MATERIALS AND METHODS

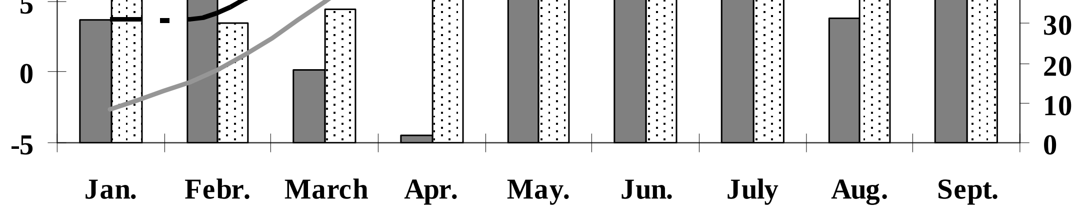
The experiments were carried out on typical meadow soil in four repetitions in the period of 2007-2008. The organic matter content of the meadow soil was 4.2% and the groundwater level was 2-2.5 m.

The soil could be characterized by high clay content and poor phosphorus and medium potassium contents.

Weather varied greatly among the experimental years. 2007 was a dry year, the amount of precipitation in the vegetation period of maize was 303.2 mm and 355.6 mm in 2007 and 2008, respectively. The 30-year average of precipitation (April-September) was 345.1 mm. The amount of precipitation was 41.9 mm lower and 14.1 mm higher in 2007 and 2008, respectively, than the average of 30 years.

The monthly mean temperatures in the vegetation period of maize were 1.96 ^{o}C and 0.6 ^{o}C higher in 2007 and 2008, respectively, than the average of many years.

Weather data of 2007 and 2008 are presented in *Figure 1*.



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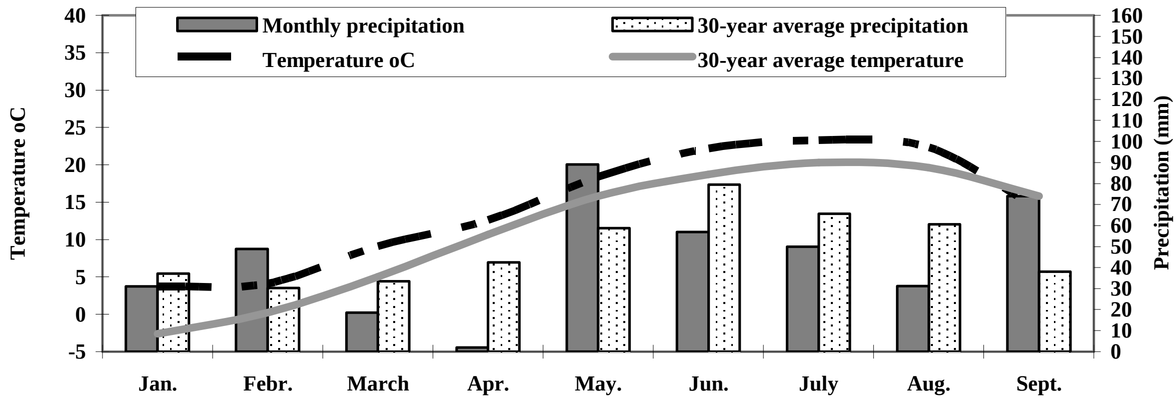

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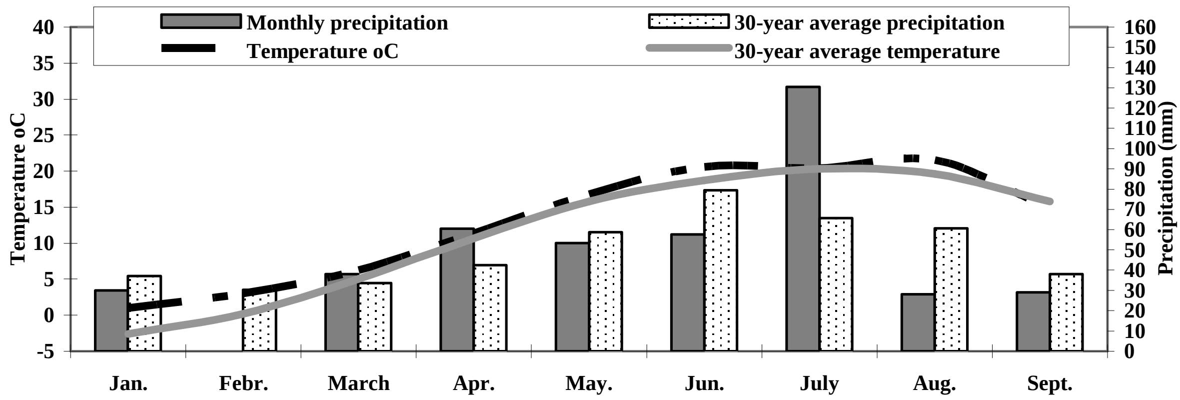


In the plant density and sowing time experiments, the standard nutrient supply was N 120, P_2O_5 80, K_2O 110 kg ha^{-1}.

The fertilizer rates (active ingredient kg ha^{-1}) applied in the fertilization experiments were N 40, P_2O_5 25, K_2O 30 kg ha^{-1} as a basic dose while the highest dose was fivefold the basic dose.

In the sowing time experiment, sowing was performed on 10 April, 25 April, 15 May. In the plant density experiment, the relationship between plant density and yield was analysed at plant densities of 45, 60, and 75 thousand plants ha^{-1}.

The results were evaluated by analysis of variance and parabolic regression analysis.

RESULTS AND DISCUSSION

Weather in 2007 was unfavourable for maize. Plant density and NPK fertilization greatly determined the yield of maize hybrids. Without fertilization, the yield was 3.68-5.19 t/ha. The lowest fertilizer dosage of N 40, P_2O_5 25, K_2O 30 kg ha^{-1} increased the yield by 2-3 t ha^{-1}. The optimum fertilizer dosage was N 120, P_2O_5 75, K_2O 90 kg ha^{-1}.

The highest yields were obtained for hybrids PR38B12, PR38V45, PR37Y12 at a plant density of 75 thousand plants ha^{-1} and for PR38A79 and PR37N01 at a plant density of 60 thousand plants ha^{-1}, while the yield of the hybrid PR35F38 was below 8 t ha^{-1} at all three plant densities *(Figure 2)*.

Figure 2: **The effect of plant density on the yield of maize hybrids in the average**

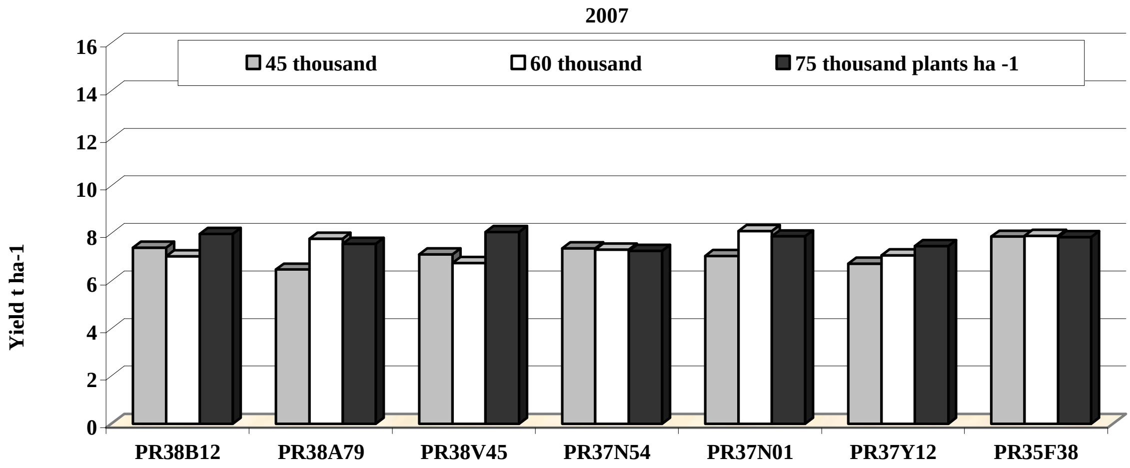
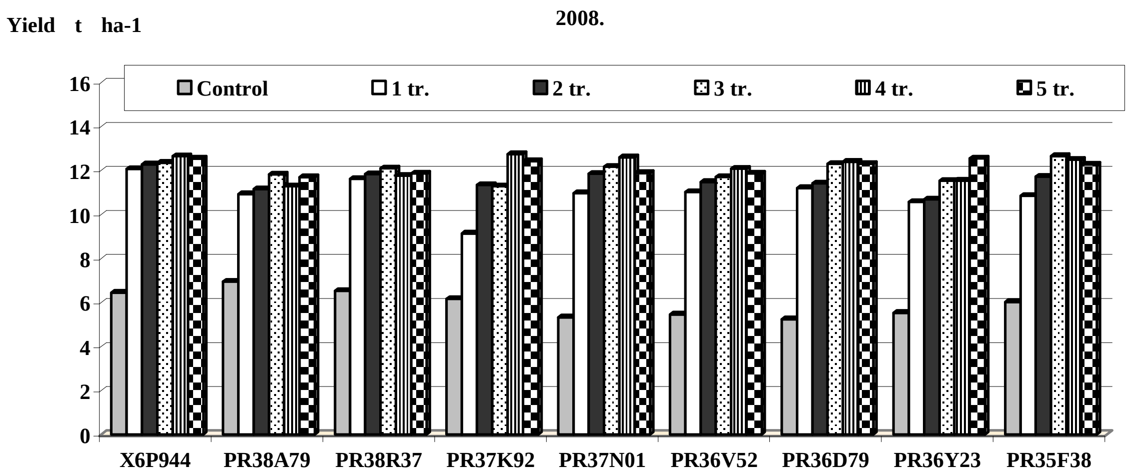


Figure 3: **The effect of fertilization on yield of maize**



In 2008, the correlation between fertilization and yield was very tight. The lowest fertilizer dosage of N 40, P_2O_5 25, K_2O 30 kg ha^{-1} increased the yield by 3-5 t ha^{-1} as compared to the control (non-fertilized) plot, while there were only slight differences among the different fertilizer dosages, the cause of which was the significant mineralization of organic materials due to the favourable year.

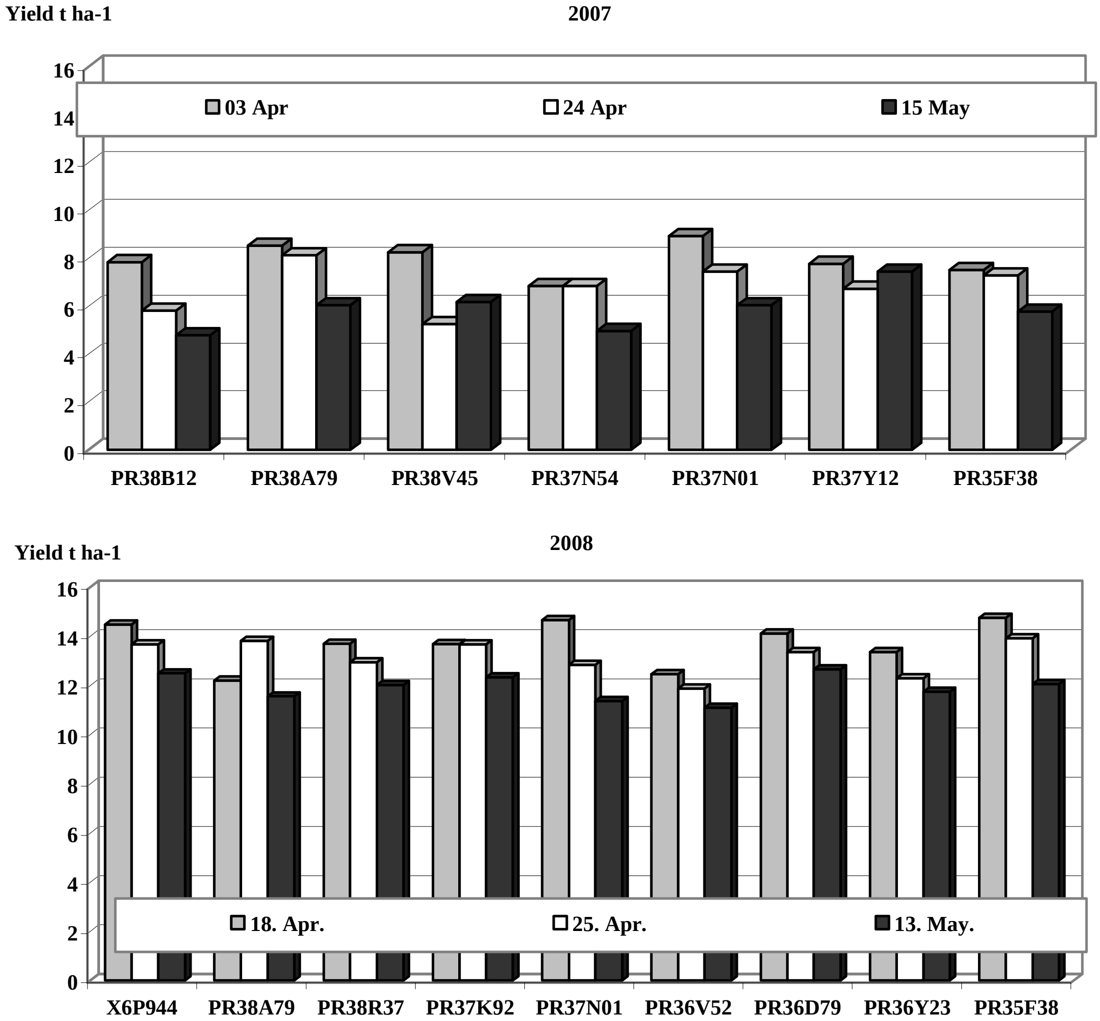
The yield of the hybrids PR38A79 and PR38R37 was above 6 t ha^{-1} even without fertilization. The best fertilizer responses were obtained for hybrids PR37K92 and PR36Y23 *(Figure 3)*.

Plant density greatly increased yield. The highest yields of hybrids were achieved at the plant density of 75 thousand plants ha^{-1}.

In 2007, the highest yield was obtained for the second sowing time (25 April) for the hybrid PR38A79, while all the other hybrids reached the maximum yield at the first sowing time (10 April). The yield of hybrids ranged between 5.5 and 9.0 t ha^{-1} depending on the sowing time.

In 2008, the yield of hybrids ranged between 11 and 14 t ha^{-1}depending on the sowing time due to the favourable year. The hybrids had a higher yield when the first sowing time (10 April) was applied *(Figure 4)*.

Figure 4: **The effect of sowing time on the yield of maize on Hajdúböszörmény, 2007-2008**



Sowing time also determined the grain moisture content at harvest. Depending on the hybrid and sowing time, the grain moisture content at harvest in 2007 varied between 11.07 and 13.70% (average: 12.39%), 11.33 and 24.60% (average 17.97%) and 21.73 and 32.60% (average 27.17%) for the first, second and third sowing time, respectively.

In 2008, it was 11.93-17.87 (average 14.90%), 13.33-20.60% (average 16.97%), 15.07-27.07% (average 21.07%) for the first, second and third sowing time, respectively.

It can be concluded that the grain moisture content can be reduced by 3-5% and 5-10% when applying the first sowing time as compared to sowing on 25 April and 15 May, respectively.

N fertilization increased the protein content of maize hybrids by 0.5-1.0%, a higher plant density reduced the protein content and slightly increased the starch content of the grains.

CONCLUSIONS

It can be concluded that the optimum NPK fertilizer dosages of the studied hybrids are N 40-120, P_2O_5 25-75, K_2O 30-90 kg ha^{-1} active ingredient depending on the hybrid and the year. Plant density is a major determining factor of yield.

Maize hybrids gave the highest yield at the plant density of 75 thousand plants ha^{-1}. With increasing plant density, the individual yield (cob size) was reduced, but the yield per unit area (ha) increased.

The yield was higher while the grain moisture content at harvest was 5-10% lower at the earlier sowing time (10 April), which results in lower drying costs.

The application of fertilization, plant density and sowing time should be hybrid-specific.

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A főbb termesztési tényezők hatása a kukorica termésére