Evaluation of genotype and crop production factors on bio-ethanol production from maize in Hungary

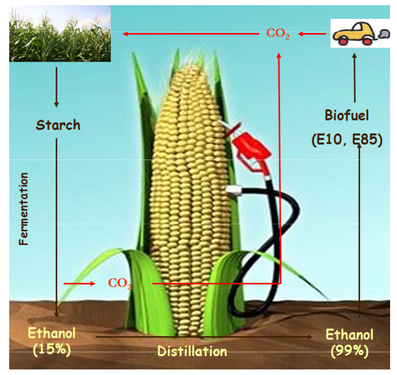
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INTRODUCTION

The importance of maize processing for industrial purposes increased significantly in Hungary. Maize is currently the single raw material of bio-ethanol production. The cultivation conditions of Hungary are perfect for maize production, maize is grown on the quarter of cultivable land (1.2 million ha). Hungary still maintains the production prohibition of genetically modified maize in spite of the suggestion of the European Commission, therefore we can produce only regular (non-GMO) maize hybrids for bio-ethanol purpose.

The objective of investigation is the improvement of the quantity and more efficient production of bio-ethanol obtained from maize grain by means of choosing the most suitable hybrids and cultivation technology

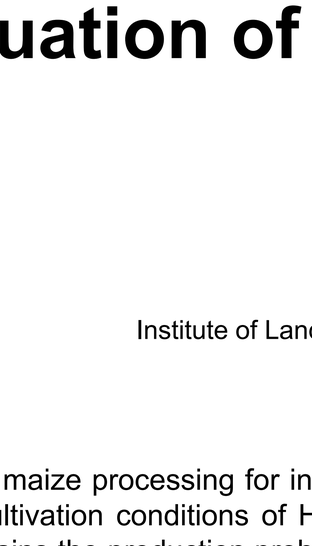


MATERIAL AND METHODS

➢ Site: Field experiment at the Látókép Experimental Station of the Centre of Agricultural and Applied Economic Sciences, Debrecen University, Hungary (HAJDÚSÁG loess-plato, 47° 30' N, 21° 36' E, 121 m elevation)

➢At the trial site polyfactorial long-term cultivation trial have been being carried out for two decades (Figure 1-2).

➢Irrigation and cultivation are in the main block, while fertilization is examined in randomized blocks with four repetitions:



Treatments:

Tillage
T_1 = winter ploughing
T_2 = spring ploughing
T_3 = shallow spring tillage

Irrigation
I_1 = non-irrigated
I_2 = irrigated

Plant density
P_1 = 50.000 plants ha^{-1}
P_2 = 70.000 plants ha^{-1}

Fertilization
M_1 = without fertilization
M_2 = 120 N kg ha^{-1} +P+K
M_3 = 240 N kg ha^{-1} +P+K

Figure 1: Polyfactorial long-term cultivation trial

➢We set up random block layout maize field experiment to evaluate of starch yield and nutritional characteristics of commercial maize hybrids in Hungary from the aspect of bio-ethanol production (Figure 3).

➢The starch content determination of the maize hybrids was carried out with a Foss InfratechTM 1241 type crop analyzing device (Figure 5).

RESULTS

➢ 4.51% difference between the maize hybrids can be found with the highest (74.34%) and the lowest (69.82%) starch content (Figure 6).

➢ According to our results, significant difference can be found between the starch content and starch yield of the examined maize kernels (Figure 7).

➢ The starch content and protein content had a moderate negative correlation (Figure 8).

➢The yield of maize did not influence the starch content of the maize kernels (Figure 9).

➢The increasing fertilizer doses decreased the starch content of the maize per dry matter (Figure 10).

➢The fertilizer doses increased the starch yield of maize parallel with the increase of grain yield, the maximum value was obtained in the case of 120 kg ha^{-1} Nitrogen level. (Figure 11).

➢Tillage treatments caused significant effect on the starch content of maize kernels, the maximum value was obtained in the case of shallow spring tillage systems. (Figure 12).

➢The lowest bio-ethanol production (2880 liter ha^{-1}) resulted from 0 kg N ha^{-1} fertilization level of spring plowing treatment, the highest bio-ethanol production (5756 liter ha^{-1}) resulted from 120 kg ha^{-1} N fertilization level of winter plowing treatment (Figure 13).

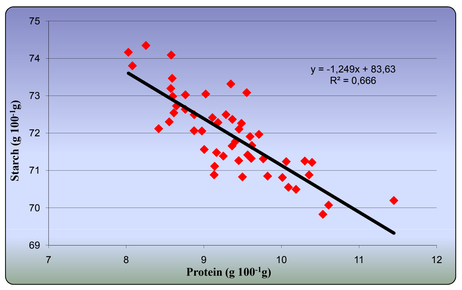


Figure 8: Correlation between protein content and starch content of the maize kernels

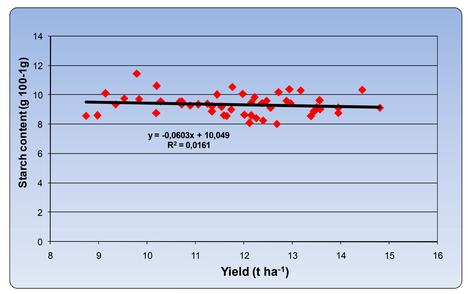


Figure 9: Correlation between maize yield and starch content of maize kernels

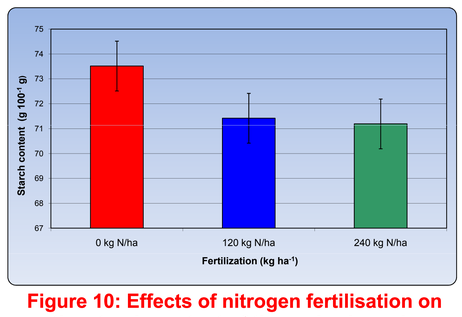


Figure 10: Effects of nitrogen fertilisation on the starch content of the maize kernels

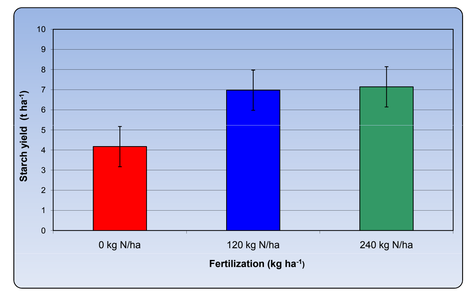


Figure 11: Effects of nitrogen fertilisation on the starch yield of the maize

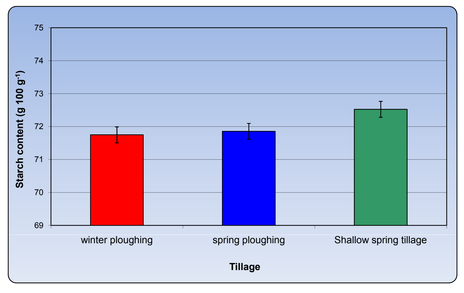


Figure 12: Effects of tillage systems on the starch content of the maize kernels

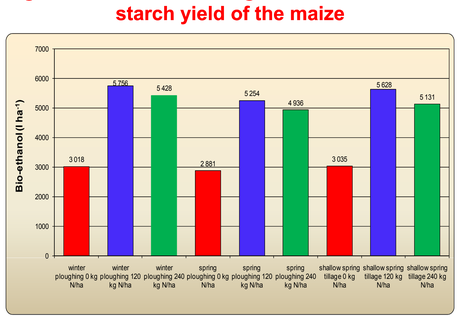


Figure 13: Effects of fertilization and tillage on the bio-ethanol production from maize

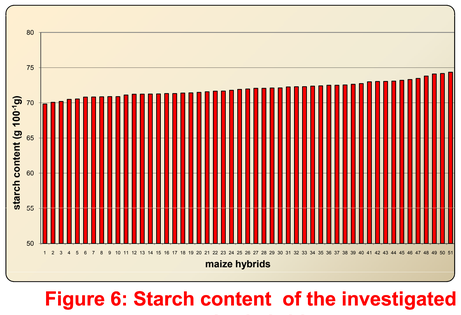


Figure 6: Starch content of the investigated maize hybrids

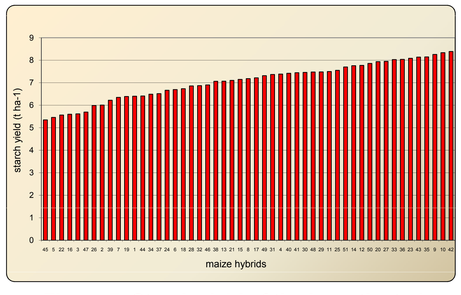


Figure 7: Starch yield of the investigated maize hybrids



Figure 2: Polyfactorial long-term cultivation trial



Figure 3: Randomized blocked maize field experiment



Figure 4: Maize samples for bio-ethanol production



Figure 5: Foss InfratechTM 1241 Grain Analyzer

CONCLUSIONS

➢ Our studies reveal that maize as a raw material of bio-ethanol production should be selected based on the cultivation objectives.

➢ There is a significant difference among commercial maize hybrids in Hungary in terms of characteristics determining the producible amount of bio-ethanol.

➢ In order be able to more thoroughly understand the hybrids getting into common production, the factors influencing quality have to be examined to a more detailed extent.

➢ Starch content and starch yield of maize kernels were significantly affected by fertilization and soil tillage systems.

ACKNOWLEDGEMENT

This project was supported by FP-REGPOT-2010-1, UD_AGR_REPO