

Bioethanol produced from maize

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Abstract

The objective of the preparation of this paper is to increase bioethanol production, to develop theories in the case of corn hybrids of high starch content, and to study hybrids that are the most favourable in terms of bioethanol production and to identify them by means of laboratory examination based on absorbed electromagnetic radiation in the near-infrared region of spectrum. This research is part of a several step laboratory examination which aims to detect the most suitable maize hybrids for bioethanol production analyzing a great number of maize hybrids.

Keywords: *biethanol, starch, maize hybrids, land use, employment*

Introduction

This examination was the first of a several stage study to select the most suitable maize hybrids which later may be the feedstocks of bioethanol plants in Hungary.

EU bioethanol policy (Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport): The biofuels directive expressed the clear intention of "promoting the use of biofuels in each Member State, with a view to contributing to objectives such as meeting climate change commitments, environmentally friendly security of supply and promoting renewable energy sources". The biofuels directive includes not only a target for 2010 (5.75% share of the market for petrol and diesel in transport) but also an interim target for 2005 (2%). Member States were required to set indicative targets for 2005, taking this reference value into account (http://ec.europa.eu/energy/res/legislation/biofuels_members_states_en.htm).

Bioethanol feedstock: The selection of the most appropriate feedstock for ethanol production strongly depends on the local conditions. Evidently, European countries such as Hungary plans to base its ethanol industry on starchy materials due to the agro-ecological conditions. Hungary is situated in Europe's corn producing zone therefore, one fourth of all tillage area is occupied by corn fields (Nagy, 2006). For ethanol production purpose big variations in different maize hybrids occur in starch content. From 50-70% of the bioethanol processing costs originate from feedstock costs, therefore it is essential to improve ethanol yield from the purchased cereals. Several international seed corn distributors and Hungarian research stations are trying to develop higher extractable and fermentable starch containing maize hybrids. The starch content is analyzed by means of laboratory examination based on absorbed electromagnetic radiation in the near-infrared region of the spectrum. This method allows a better maize hybrid selection for plants using the dry milling process. During large scale dry milling examinations the bioethanol yield of HTF (High Total Fermentable) hybrids were compared to traditional hybrids bioethanol production. The results proved that HTF hybrids bioethanol yield exceeded traditional maize hybrid production by 1-4,7% (Hingyi et al., 2006).

Ethanol production from corn: Corn can be extensively used in bioethanol production (pre-stored as maize silage for all year round). Fuel ethanol production (dry milling process) is a

five step process: 1. raw material production, 2. hydrolysis, 3. fermentation, 4. separation and dehydration and 5. the treatment of wastewater (http://www.sciencedirect.com.hu/science?_ob=ArticleURL&_udi=B6V24-4RFD3MX).

Land useage: The Hungarian regional and labour productivity measured by gross value added takes only 30-40 % of that of EU-15 average. Despite the excellent site conditions this comparison reflects the reduction of Hungary's agricultural feature.

Regarding the employment rate in the EU Hungary is among the lasts (ages 15-64: 57%). The employment is more complex at regional level than national level (*Harsányi et al., 2007*).

Bioethanol production of Hungary: Plants for bioethanol production have worked in Szabadegyháza, Győr and Kaba so far, however, several more factories are planned to establish for further bioethanol production.

Materials and methods

The information basis of the research comes from the annual reports of Hungarian agriculture, the National Development Plan and the Operational Programmes.

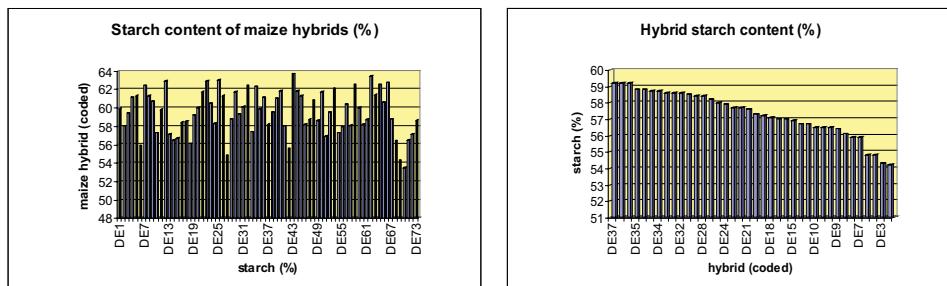
Raw materials: over 70 maize hybrids used in Hungary. During the first step of this examination more than 70 maize hybrids were selected and analyzed, which are often used in the Hungarian agriculture. The maize samples were harvested one month before the examination from the farmlands of the Northern Great Plain Region. The conditions of nutrient and irrigation were similar on each farmland. Infratec 1241 Grain Analyzer is a Near Infrared Transmission (NIT) instrument which is capable of simultaneous and accurate determination of several constituents in whole grain samples. The measurements are based on the fact that the main constituents in the grain (corn), such as protein, moisture, starch, fat and others, absorb electromagnetic radiation in the near-infrared region of the spectrum. Since the Infratec 1241 Grain Analyzer uses transmission absorption, sample preparation is unnecessary.

Results and discussion

The Near Infrared Transmission (NIT) examination detected, oil, protein, moisture, test weight as well as the starch content of all the 73 hybrids. Results were displayed and dumped via a modem cable to a PC. After having all the results statistical tools were used to organize the database. The data of starch content (%) was evaluated with various statistical methods. The comparison of samples showed a significant difference between the various maize hybrids starch content (*Figure 1*). The smallest starch content measured was 53,5% which seems to be insufficient for energy purpose production of bioethanol. Hybrids with 60-62% starch content or less are only eligible for different utilization (animal feed, human consumption etc) (*Figure 2*). The more starch contained by the corn seed the more favourable it is for bioethanol production. Maize hybrids of 65% or above starch content are by all means worth for further researches to define the possible ethanol yield. The quantity of bioethanol to be extracted from traditional maize hybrids and HTF (*High Total Fermentable*) (*Figure 3*) hybrids were compared to each other in large-scale dry mill analyses. The bioethanol yield of HTF hybrids exceeded those of traditional hybrids by 1-4.7% in each plant (*Hingyi et al., 2006*).

From the point of bioethanol production, it is not only the quantity of starch, but also its constitution – the proportion of amilose and amilopectin – that is of the greatest importance. The proportion of these two significantly influences the chemical characteristics of starch. The amilopectin content of starch changes between 70 and 80 % per plant species. The

more amilopectin content of a maize hybrid the easier it is to produce bioethanol from its viscous solution.



The actual bioethanol production capacity in Hungary is around 80,000t. The two operating plants (Szabadegyháza, Győr) are investing in development to increase production. Hungary would achieve the reference value of 5.75% by 2010 formulated by the EU Directive due to the enlargement of capacity by the two factories. Despite this, different investment companies announced the establishment of plants for bioethanol production, being suitable for processing different feedstock of about 7.5 million t, in 20 places by autumn of 2006. The ethanol-biogas plant in Kaba requires feedstock of 300,000 t/year (30000-35000 ha) with which it considerably contributes to bioethanol yield produced in Hungary (*European Environment Agency, 2006*).

The sectoral structure of Hungarian labour market: The sectoral structure of labour market generally changes in long term therefore a decrease of almost 13% in agriculture during the last one and a half decades can be considered marked. In 2005, 5% of the employed people worked in agriculture, about one third of them have jobs in companies in industry and construction and 62.3% of them work for the service sector. In north and south regions of the Great Plain, agriculture has a traditionally outstanding role in employment; in these regions the ratio of the sector is nearly double of the national average (*Bocz et al., 2007*).

Conclusions

According to economic forecasts, the demand for maize is expected to increase continuously on the European and World market. Maize has been playing a decisive role in the Hungarian plant growing for decades. The Hungarian crop and seed production – considering the excellent Hungarian ecological conditions – and the use of Hungarian hybrids has a determining role in the agricultural production and export, as well as in the increase of the income producing capability in rural areas. The success of maize production is provided by the improvement of the yield stability of maize hybrids.

Therefore it is an important task to choose the hybrids best suitable for the regional fundamentals. It is not an easy task, as the number of hybrids authorised for common growing was 365 in Hungary in 2006.

It is also an essential task to solve the employment problems in Hungary. The outputs of grain sector are acknowledged on an international level also. Owing to our ecological fundamentals, traditions and expertise, this sector has significant comparative advantages compared to the fundamentals of several European countries. On one hand we really have significant results regarding volume and outputs, on the other hand the efficiency of production, the profit producing ability, the degree of the products' processing and the logistics background show a great backwardness compared to that of the more developed

European Union states (*Harsányi et al., 2006*). Hungary's undertaking to raise the proportion of biofuels expressed in energy content to 5.75% within its fuel consumption for traffic purposes until 2010 is an important circumstance. Relying upon these, the subsistence possibilities of those working in the grain sector show a positive picture. The available arable land for dedicated bioenergy crop cultivation of Hungary will continue to raise for 413,000 ha until 2010 and this tendency will grow further on basis of CAPSIM-calculations. Parallel to this tendency, the employment rate of agriculture will increase as well, solving the problem of unemployment.

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