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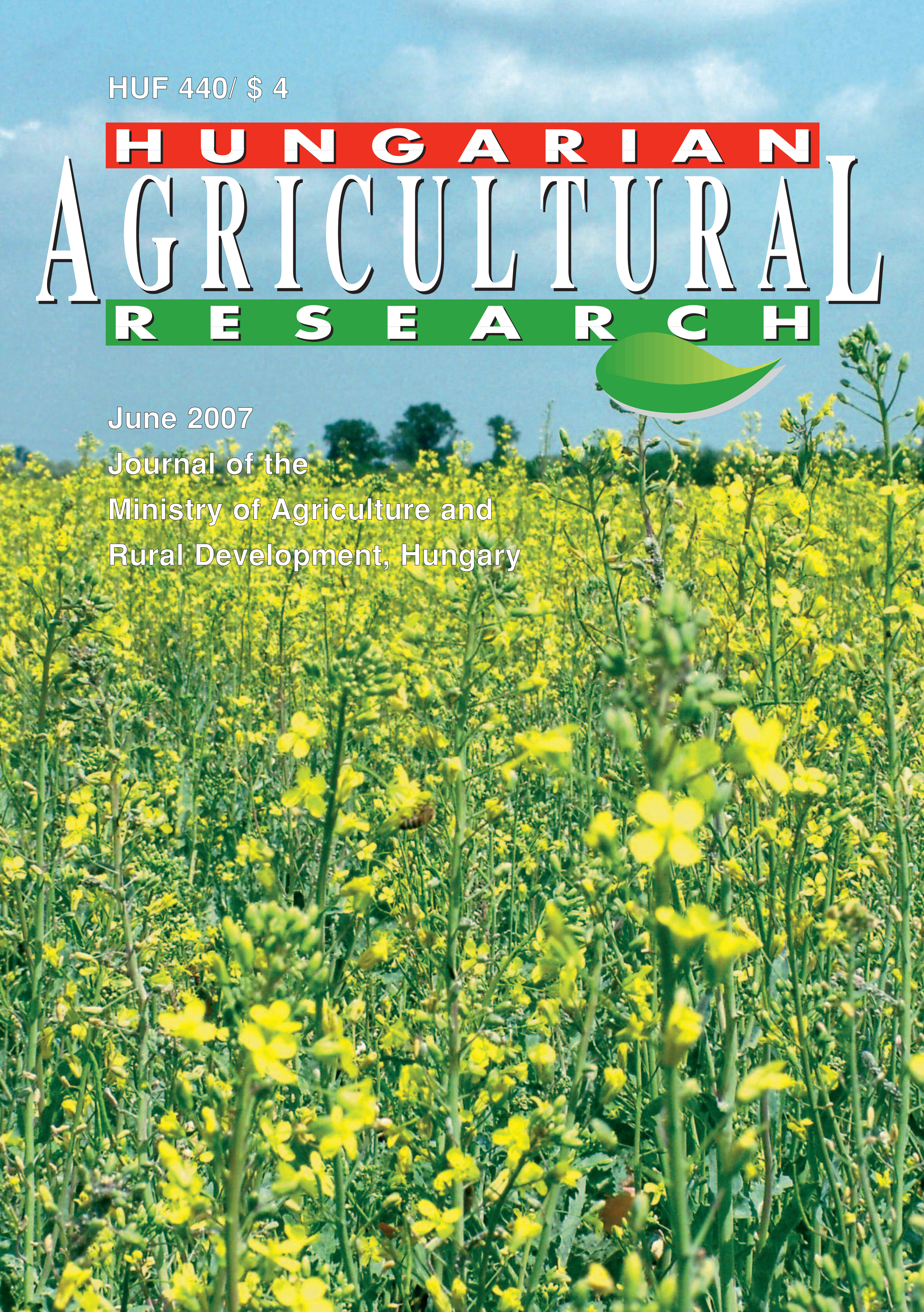

53rd Plant Protection Scientific Days

20–21 February, 2007, Budapest, Hungary

Plant protection is a well-recognized discipline of Hungarian agriculture all over the world. Plant protection activities in Hungary are extremely good as compared to other EU countries; no similar trainings in plant protection area are available in most countries.

The main activities of the Plant and Soil Protection Services are the plant health control, examinations on permission and use of pesticides, observation of soil and soil waters and to guarantee safety food.

Sixteen to seventeen thousand tons pesticides are used in Hungary every year, which is equal to 8–10 thousand tons of active ingredients. The income of pesticide trade is consistently around 50–55 milliard HUF for a year, depending on meteorological factors, and suggests the market stability of this area.

The first plenary presentation of the Plant Protection Scientific Days was delivered by Prof. J. Horváth, ordinary member of the Hungarian Academy of Sciences, the president of the Plant Protection Society of Hungarian Agricultural Association, titled with ”Quo Vadis Agrarian Science”.

This was followed by the welcome ceremony of J. Gráf, a minister at the Ministry of Agriculture and Rural Development (MARD). An oral presentation was delivered by G. Gólya (Department of Food Chain Safety, Animal- and Plant Health, MARD), titled with the “Changing in the plant protection administration department”.

Besides these the following presentations were delivered in the plenary session:

Genetical evaluation of the transgenic plants (L. Heszky); Environmental scientific results about DK-440 BTY genetical modified (MON 810) maize (B.Darvas, É. Lauber and A.L. Polgár); Transgenic plant and ecological farming (P. Roszik).

After the plenary session, some awards of the Plant Protection Society of Hungarian Agricultural Association were given, the most prominent from these was the golden degree of Life Tree delivered to Prof. Tibor Jermy, ordinary member of the Hungarian Academy of Sciences, by the minister of the Ministry of Agriculture and Rural Development.

After the plenary session, the presentations were continued in the different sections (Agrozoology, Plant pathology and Herbology). Altogether 60 oral presentations were delivered about the prominent scientific results of the sections. Oral presentations were completed with 30 posters.

J. Horváth
President of the Plant Protection Society
of Hungarian Agricultural Association

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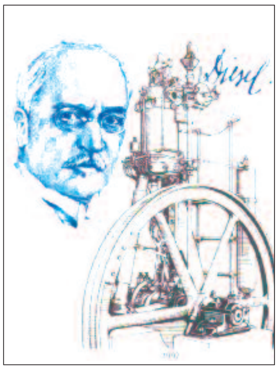
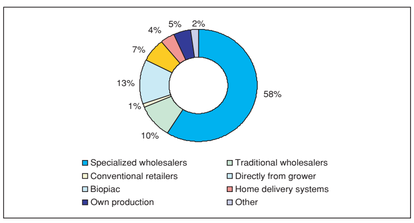
Blooming rape field
(Photo by J. Bakk)



Page 6

Page 11



Page 18

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Miklós Neményi[1]

Liquid Biofuels – Present and Future

The Program aiming the assessment of Hungary's agroecological potential – led by István Láng in the 1980's [1] – established that Hungary is well-supplied with biomass energy sources, as the carbon amount fixed by plants yearly is much higher than the carbon content of imported and produced fossil energy sources. The proportion is valid for the present time, while it is true that the country is becoming more and more dependent on natural gas and crude oil imports. This fact underlines the urging necessity of utilizing renewable, primarily renewable bio energy sources at a much greater rate.

Blooming rape field (photo by M. Neményi)

The ecological and environmental protection benefits of biofuels are undeniable: carbon dioxide and sulphur emissions to the atmosphere – the main causes of the greenhouse effect – are eliminated or reduced; they decompose in nature. At present, the economic angle is not clear, as the exact costs of the unfavourable effects caused by the burning of fossil energy sources are yet to be determined.

Prior to World War II, Hungarian agriculture produced its energy demand – fodder – on 15–20% of the arable land. Nowadays, a smaller area, 10% of the arable land would be sufficient to cover the liquid energy source needs of the agricultural sector. 3.6% of Hungary's energy consumption is ensured from renewable energy sources. Fuel wood takes the lion's share, at 70%. Fuel wood should be mentioned only if the burning takes place in modern burning facilities with continuous emission control. Unfortunately, the production of liquid biofuels has not yet begun in Hungary *(Figure 1).*

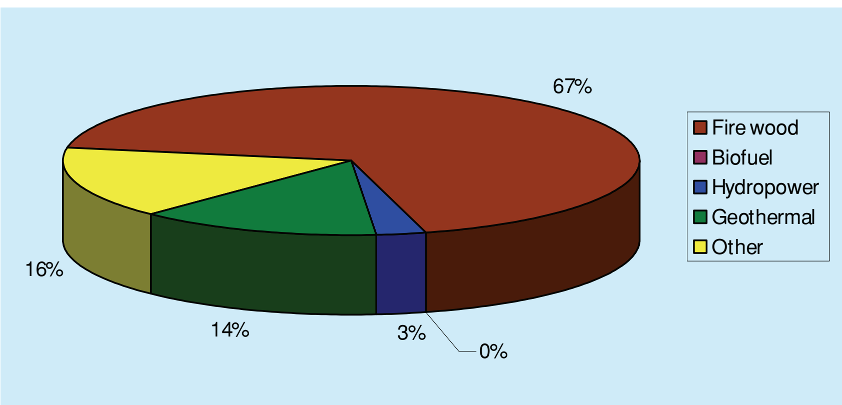

Figure 1. *Percentage of renewable energyresources in Hungary*

Renewable energy sources can be divided into two groups: bio (plants) and abiological (hydro and wind energy). Solar and geothermal energy are usually men-

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Presented on 29 November, 2006 at the Section of Agricultural Sciences of the Hungarian Academy of Sciences

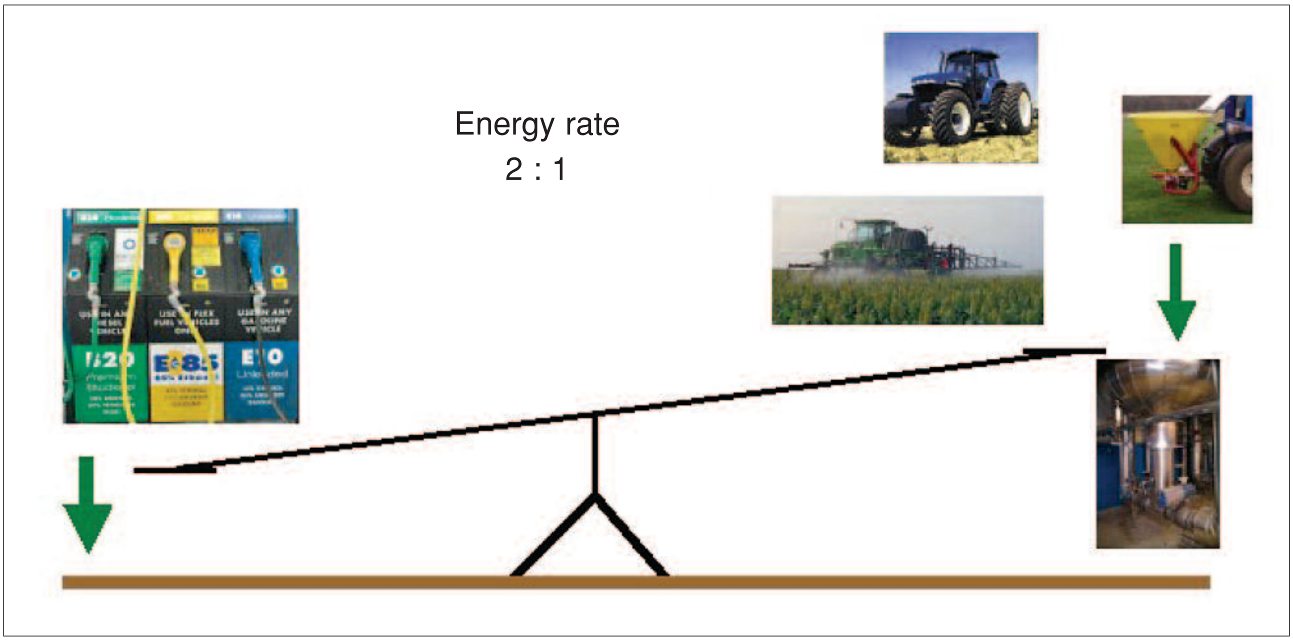


Figure 2. *Energy balance of ethanol production from wheat (using the grain yield)*

tioned here as well, though they are actually environment-friendly energy sources, not renewable ones in the classical sense.

Energy is an essential source of life and at the same time determines evolution. Let's take a look into the energy balance of plant production: Photosynthesis is the carbon assimilation of plants; with the help of solar energy organic compounds form from carbon dioxide and water. The efficiency of this process can be improved by various breeding procedures (either conventional or based on gene technology), plant production technologies, etc. The grown plants are enlightened from the competitive influences of the given environment, they are protected from pests, diseases and weeds; the soil is brought to an optimal condition, if needed irrigation is applied and nutrition replenishment are ensured. These measures, the used material, etc. represent energy, or their production requires energy consumption.

The study of the energy utilization of plants is a special field of science. The energy rate is a generally used index. It is the proportion of the ”produced energy” and the energy used during plant production. The heating value of the produced plant is the energy output. Regarding input, energy source utilization is considered either indirect (the heating value of the energy source) or direct (energy requirement of the used material and appliances: fertilizers, plant protecting agents, machinery, appliances, etc.). The energy rate should be used cautiously in the analysis of individual technologies, as the characteristic of this function is that it continuously (naturally not linearly) decreases with increased input. In nature, in natural ecological systems the energy rate is infinite, as there is output, but no input, so the ”value” is divided by 0. That is why I previously introduced the energy difference function, which has a maximum and therefore, an optimal energy input can be determined for the given conditions [2]. The fertilizer recommendation system developed by the Research Institute for Soil Science and Agricultural Chemistry (RISSAC) of the Hungarian Academy of Sciences and the Agricultural Research Institute of the Hungarian Academy of Sciences (Martonvásár) has been tested under farm production conditions in the past seven years. The model takes numerous parameters (physical and chemical soil properties; forecrop; data of the yield map, etc) into consideration and makes possible ecological, environment protection and economical optimization, even on some hundred square meter areas within a field. It was found that the energy input of the production technologies are very efficient, there can be inputs of such proportion, however, with which more can be lost than gained.

In the case of maize and cereals the energy rate can be as high as 6 for the harvested whole plant, 2–3 if only the grain yield is considered, and if ethanol is produced from it, then the overall energy input unit results in 1.5–2 units of energy. For oilseed rape and sunflower – similarly to the abovementioned maize and cereals – the energy output and input rate is 5–6 for the whole plant, and 2–3 if calculating only with grain yield, and when ethanol is produced from it, a unit of total energy input results in 1.5–2-times more energy *(Figure 2)*. It may seem incredi-

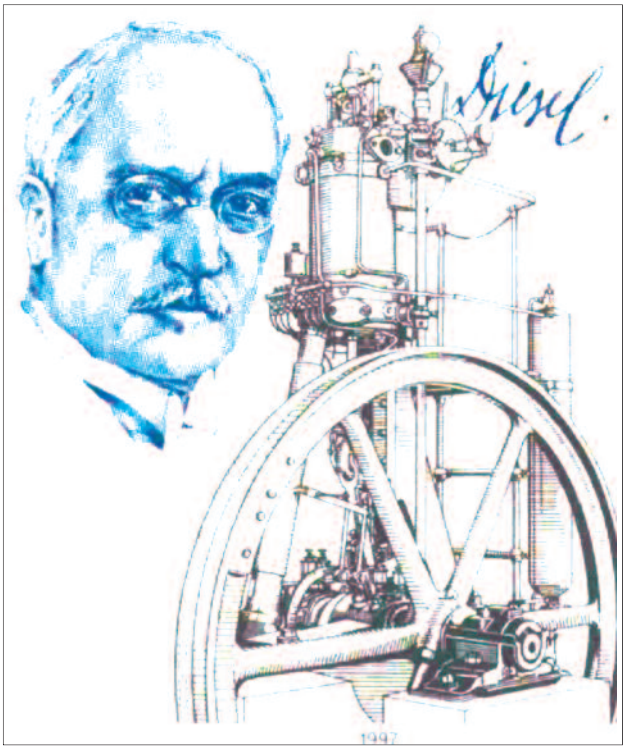


***Figure 3.** "The use of vegetable oils for engine fuels may seem insignificant today. But such oils may become in the course of time as important as the petroleum and coal tar products of the present time" Rudolph Diesel (1912)*

***Figure 4.** "The fuel of the future is going to come from fruit like that sumach out by the road, or from apples, weeds, awdust – almost anything…" Henry Ford (1925)*

ble, but it is a verified fact that the production of gasoline requires greater energy input than it represents.

The possibility of using liquid fuels of plant origin arose at the beginning of mechanization: Rudolph Diesel (1912) and Henry Ford (1925) drew attention to the importance of biofuels *(Figure 3, 4)*.

Let's go into details about plant fatty acids: 10% of the World's biofuel production is shared by vegetable oils, and 95% of these are produced in Europe. Primarily oil seed and sunflower oil are used on our continent, although any vegetable oil can be included (palm oil, soy oil).

There are two possibilities of using plant fatty acids as fuels:

Direct utilization:
- in suitably modified engines;
- blending with diesel fuel;
- pre-heating (e.g. with the cooling water of the internal combustion engine);
- or reducing viscosity with additives.

The direct utilization of vegetable oils is inhibited by several – relative to diesel fuel – unfavourable characteristics: higher consistency, 8–10-times higher viscosity, which is unfavourable from the point of view of carburization; lower cetane number, resulting less favourable combustion quality. For improving these characteristics vegetable oil is transesterified to biodiesel.

Indirect utilization, when a fuel similar to diesel fuel is produced: the vegetable oil is transesterified,

Microwave activation of enzymes

its viscosity is reduced. (Plant fatty acids are triglycerides, which are the ester linkages of glycerol and different fatty acids. Glycerol is usually esterified with three fatty acids.). During transesterification usually methanol is combined with vegetable oil, resulting in a fatty acid methyl ester. The molecular structure of this product is very similar to the hydrocarbons of the paraffin forming diesel fuel.

Ethanol production constitutes 90% of the World's biofuel production. It is becoming more and more widespread. In respect to grain yield, in Hungary primarily maize and wheat can be considered for biofuel, or bioalcohol production purposes, as these plant species produce the highest alcohol output per unit mass.

A Consortium was established to develop the production conditions of plant-based biofuels and to organize their environment protection aimed utilization. The member institutions and specialists of the Consortium are: Szent István University, László Heszky; University of Debrecen, János Nagy; University of Pannonia (Jenő Hancsók); IKR Joint-Stock Company, Gábor Antos; Szolnok College, Ferenc Farkas; University of West Hungary Miklós Neményi.

The University of Debrecen research team is engaged in production technology developments, public opinion research and logistics tasks. The research team in IKR JSC. is working on the development of adapting the burners of grain drying systems to vegetation oil. Biofuel tests are being run on engine testing-benches by the Szolnok College team. The researchers of the University of Pannonia (Veszprém) have been successful in increasing the efficiency of transesterifying with the use of enzymes [3]. (This procedure is of high priority in the EU 7 Framework.) This technology, however, infers the modernization of process control.

Rape field in June (photo by J. Bakk)

László Heszky and his coworkers are concerned with the development of the biological basis of biofuel and bioalcohol production: on the one hand with the breeding of oilseed rape and sunflower hybrids with high oleic acid content and yields. (The fatty acid composition mainly determines the consistency, the cetane rating, oxidation stability, viscosity, flash point, etc. of the product. Hybrids with high oleic acid content are the most suitable for biodiesel production.) On the other hand, the breeding of maize hybrids and wheat species with high starch and amylopectin content is going on for increasing alcohol output [4]. The breeding of compact stalk wheat species has been restarted at the Cereal Research Non-profit Company (Szeged). This work is significant also because in the above-mentioned Framework Plan alcohol production from cellulose basic material has a high priority. If in addition to the grain yield, straw is also used as basic material, the alcohol quantity produced per hectare can be increased significantly.

The Institute of Biosystems Engineering of the Faculty of Agricultural and Food Sciences (University of West Hungary) investigates which oilseed rape and sunflower hybrids are the most suitable for biofuels or transesterifying. With the procedure developed at our Institute the

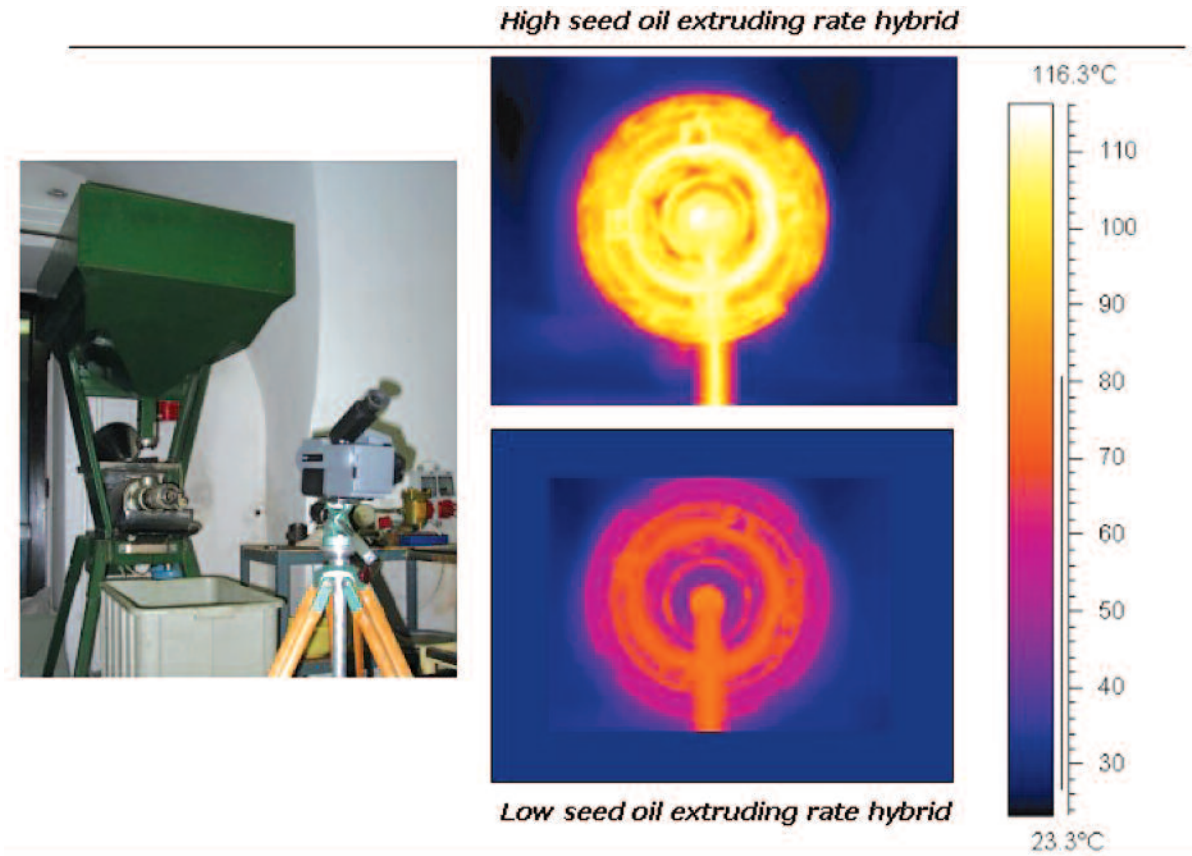


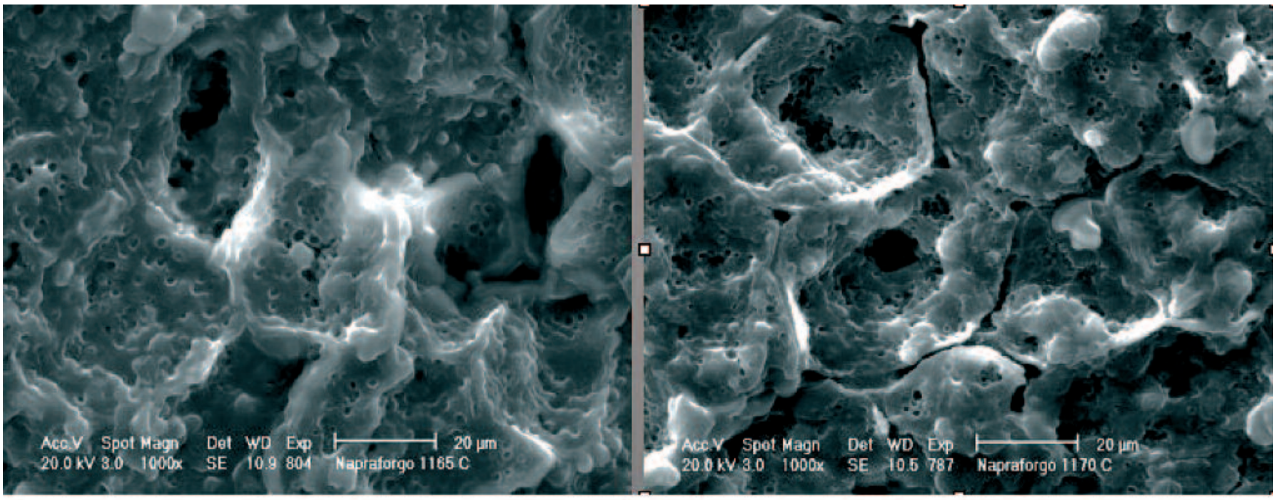
Figure 5. *Investigation of different sunflower seed oil extruding rate by thermo vision camera of different hybrids*

presurization can be followed easily by means of a thermal camera. The temperature of well-presurizable hybrids is higher than those with lower pressuring characteristics *(Figure 5)*. This property is identified by the structure of the kernel and husk. The electron microscopic images show channel-like formations in the kernel of well-presurizable hybrids *(Figure 6)*. Experience proves that in the case of 40–50% of the hybrids included in production or species adaptation one or more of the parameters do not comply with the requirements of biofuels (acid rate, Iodine-Bromide rate, coking residue, yield etc.) [5]. First in the World, we have proven that enzyme activity can be increased significantly by means of microwave treatment [6]. On the basis of these researches we have developed a procedure with which a 20–60% improvement can be achieved in the activity of cellulase enzyme (Trichoderma reesei) during cellobiose hydrolization.

The outlook of the World proves that research is going on at ”full speed”. On the one hand, in the case of plants produced with GM technology the application of plant protection agents can be reduced significantly (reducing the environment load and energy input at the same time!). On the other hand, as an example, amylases are built into the endospermium, which increases the efficiency of breaking down starch to glucose, and the energy-consuming brewing procedure can be eliminated from the technology process (Nature biotechnology, July 2006, In: Zöld Biotechnológia (Green Biotechnology), 2006/9.). The possibility of transesterifying various vegetable oils with catalysed enzymes is under study; or paper, cotton, or sawdust are decomposed by enzymes produced by GM fungus (Applied Biochemistry and Biotechnology. Vol. 135). These are only a few examples of the storehouse of investigations.

Recently purposeful investigations are being carried out aiming the production of so-called two-generation biofuels. The essentials are: the plant parts are gasified, then bio-oil or bio-diesel is produced by the Fischer-Tropsch procedure. This technology, however, raises a number of technical and scientific questions.

Epilogue: I wished to call attention to the fact that the up-to-date results of various fields of sciences – biotechnology, biotechnology industry, genomics, enzymology, plant production, soil science, informatics, climatology, ecology, technical sciences, economy, logistics – are required for the production and utilization of



a, b,

Figure 6. *a, Structure of low presurizable sunflower hybrid seed b, Structure of high presurizable sunflower hybrid seed*

renewable energy sources, and if the goal is to increase efficiency, further purposeful research work and the harmonization of results are prerequisites. No ability for foreseeing the future is needed to prognose the expressed role of bio- and gene technology in this field as well.

It is true that since 2000 the production of ethyl alcohol has doubled, of biodiesel (starting from a much lower level) trebled, while that of crude oil increased by 7%. (At present liquid biofuels represent only somewhat more than 2% of the World's energy consumption.) Taking into consideration the fact that the „apetite" of the rapidly developing countries – primarily China and India – is growing more and more, it will take many years to reduce carbon dioxide emission to the atmosphere caused by the burning of fossil energy sources. For this purposes numerous national programmes have been launched (e.g. Brazil, China, USA, EU plan to double their biofuel production within 15 years), but it is inevitable that further global regulations will be required.

I end my presentation with Dénes Gábor's (holder of Nobel Prize, Hungarian physicist) thoughts: „Till now man has been up against Nature; From now on he will be up against his own nature."

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Mesterházy, A.[1], Kászonyi, G., Tóth, B., Purnhauser, L., Bartók, T. and Szekeres, A.

Breeding strategies against Fusarium Head Blight in wheat

Introduction

The curiosity of the Fusarium Head Blight (FHB) is that genetic background and symptom development can be very far reaching because disease development is strongly influenced by morphological factors (Mesterházy 1987), aggressiveness of inoculum (Mesterházy 1983, 1995), duration of the wet period of the head, the complicated genetic background and the long flowering period of wheat genotypes. During the disease development different resistance components influence symptom development and severity as well as other traits like Fusarium damaged kernels (FDK), yield loss, toxin contamination and others. Theese often overlap each other. The result is far diverging results in resistance tests between years, locations and other conditions. The phenotyping of DH populations for medium and lower effective QTLs shows clearly this For this reason the determination of resistance needs careful work. For this several methodical rules should be applied (Mesterházy 1997). As higher resistance results mostly in lower toxin values (mostly DON content, Mesterházy et al. 2002), to increase food and feed safety means first of all to increase resistance.

High resistant wheat

Actually we can use different genetic strategies to increase resistance: **A**/ The spring wheat Sumey-3 QTLs from different crosses is extensively used and generally secures rather high resistance level. The 3BS QTL can be identified now in MAS as a service for breeders of US. The problem is here that DH lines with 3BS show highly significant differences. Therefore not every plant with 3BS QTL will have high resistance. Adapted Nobeoka Bozu lines are only in Hungary (Mesterházy et al. 1999) and their resistance is comparable to that of the Sumey-3, but QTLs for this cultivar have not been identified until now. Evaluations of DH populations are in progress. **B)** We can use more adapted spring type plant material with known less effective QTLs like from Frontana with Type 1 resistance**.** **C)** We can use adapted winter

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wheat genotypes with superior genotypes in crossing programs like cvs Arina, Renan, Bence, etc. **D)** We can check the FHB resistance of genotypes from crosses made not for FHB resistance as the experience shows that also here superior genotypes might be identified.

Materials and methods

In this paper the results of the 2002 and 2003 years will be summarized. All inoculations were made with two *Fusarium graminearum* and two *F. culmorum* isolates as described by Mesterházy (1995). Here the mean reactions to the isolates will be listed.

Results and discussion

In the past 30 years we had tested all possibilities. The most intensive work was made with Sumey3 and Nobeoka Bozu (A). Frontana and less resistant spring type materials were not used from the spring group as provided less resistance than the resistance sources in A. So their domestication did not seem to be necessary (B). Case C was represented by several crosses, but D was searched more intensively as the whole advanced material of the institute together with candidates for cultivar and released cultivars were not planned to have FHB resistance. We screened since 20 years about 1500 advanced lines. Depending of the year 20–30% of the genotypes tested had superior resistance to the check cvs. Table 1 and 2 presents the group of genotypes bred for FHB resistance. In Table 2 only the group means will be presented. All Nobeoka Bozu progenies are winter wheats with good agronomic properties. Among Sumey-3 progenies also spring wheats are present mostly from the cross Sgv/NB//MM/Sum3, but the lines from the other crosses are winter wheats. The resistance is highest in this group. However, the very low FHB values are not always accompanied by excellent FDK or DON data. The entries 163 and 210 for example have high FDK and DON ratios. This is the phenomenon late blighting. The DON content is lowest in this group, the mean is at about 10 ppm, but the resistance sources are at 1–3 ppm only.

Low resistant wheat

From the winter wheat crosses we have lines with higher susceptibility (C). FDK and DON means are four fold higher than in group A. The next group, where, through large scale screening tests. extra variants were found, has the same performance than the lines from the winter wheat crosses for FHB except the DON data that are lower. The susceptible control cultivars have the worst data in all respect. The situation is similar also for 2003.

Fig. 1 shows the FHB-FDK regression form 2002. Numerous genotypes with low or lower FHB have high FDK values. At about 20% FHB FDK data are between 13 and 70%. Similar data are present for FHB-DON *(Fig. 2)* where at 30% FHB DON varied between 6,2 and 101 ppm; and the situation is similar for FDK-DON (not shown). So we select first to low FHB severity; than FDK should be checked and discard the highly infected ones. At last a DON tests can discard the entries with higher DON contamination.

The data show that strategically the highly resistant spring wheats give the highest resistance level. The use of Nobeoka Bozu results in a similar resistance as Sumey-3, therefore to decrease possible disadvantages of only use of Sumey-3, could be highly

Table 1. *FHB resistance of genotypes originating from different breeding approaches, 2002*

Plot No.	Genotype	FHB %	FDK %	DON ppm	Rel. yield %
	Resistance sources and their progenies				
454	Sgv/NB//MM/Sum3	0.00	0.67	5.2	75.68
276	Sgv / NB // MM / Sum3	0.00	1.00	1.9	–
278	Sgv / NB // MM / Sum3	0.00	1.67	2.3	–
277	Sgv / NB // MM / Sum3	0.00	3.50	3.4	–
150	Wuhan 6B	0.03	12.56	6.6	92.16
156	Sumey3	0.54	11.22	7.4	104.12
317	Zu // Ré / NB	0.55	2.83	8.1	76.81
292	Sgv / NB // MM / Sum3	0.72	5.33	7.9	–
195	Zu // Ré / NB	0.99	3.11	3.9	95.49
286	Sgv / NB // MM / Sum3	2.03	3.33	3.9	–
183	Sum3/81.61//Kő	3.06	16.67	8.2	56.90
289	Sgv / NB // MM / Sum3	3.11	1.67	11.6	–
179	Sum3/81.61//Kő	3.15	7.61	5.3	64.23
163	Sgv/NB//MM/Sum3	3.18	26.00	13.5	68.90
210	St 902 /3/ Sgv /NB // MM / Sum 3	3.22	38.33	21.4	–
209	St 902 /3/ Sgv /NB // MM / Sum 3	3.36	12.33	8.7	–
176	RST/NB	4.12	9.67	8.3	69.73
159	Nobeoka Bozu	4.68	11.56	4.5	66.78
172	RSt//MM/NB	5.40	16.50	6.0	60.58
169	Sgv/NB//MM/Sum3	5.50	21.78	13.4	74.67
175	RST/NB	6.86	9.17	5.2	67.33
282	Sgv/NB//MM/Sum3	8.53	7.67	5.7	76.62
239	Frontana	7.00	23.56	7.0	57.04
	Mean	2.87	10.77	7.36	73.80
	Genotypes from WW crosses				
301	84.42 / 85.50	11.32	26.33	13.2	69.75
143	85.92 // Kő / In	12.63	25.00	13.3	–
189	BeSK48.21	16.20	55.00	35.1	–
196	Ttj/F379	17.55	43.67	28.8	52.92
177	RSt	18.35	27.56	28.9	44.53
53	80.1.61 // Rst / NB	21.11	35.00	20.4	55.32
52	Ke / SO 89.807	21.33	38.67	20.2	49.34
442	Ttj / RC 103	25.95	53.00	17.4	55.80
299	Zu / 85.50	30.21	62.11	23.1	49.38
115	Várkony	27.74	44.44	36.0	57.37
		22.49	45.64	26.27	62.06
	Cultivars from non FHB programs				
306	B 1201	18.08	47.72	22.31	57.15
99	Tiszatáj	23.47	71.67	19.0	60.19
123	Smaragd	25.42	45.00	16.0	–
91	Attila	25.53	39.89	10.1	68.49
82	Tenger	30.43	44.17	27.4	58.23
90	Héja	38.19	48.67	19.1	51.37
		26.85	49.52	18.99	59.09
	Popular susceptible control varieties				
13	Zugoly	44.57	80.00	51.2	32.88
77	Élet	45.91	72.22	45.6	48.26
107	Miska	47.89	77.50	68.6	43.56
104	Favorit	48.07	80.83	53.0	44.21
78	Kalász	48.42	70.00	82.3	35.87
85	Verecke	59.14	80.00	75.0	37.70
	Mean	49.00	76.76	62.63	40.41
	$LSD_{5\%}$	3.13	6.99	20.34	7.20

important worldwide. We have these lines. By their direct use in winter wheat winter hardiness problems might arise. Except several genotypes the yielding ability of such genotypes is lower than that of the control cultivars. It means that the third generation materials will be most useful for cultivar breeding. When superior winter wheats are used for crossing, the resistance achieved is similar we find at screening large scale materials from non FHB programs. Their best genotypes have similar FHB resistance than the more susceptible genotypes of the first group. We think that this resistance level is sufficient to combat medium level epidemics mostly present in Hungary with additional fungicide treatment when necessary. For higher level of epidemics highly effective QTLs are necessary to secure good or excellent food safety. Such genotypes are needed for organic farming. It is important that the winter wheat in Europe contains considerable resistance to FHB and can decrease infection severity by two third compared to the susceptible popular cultivars. Variety offices have the task to ban the way of the susceptible cultivars into the commercial production and withdraw the highly susceptible ones as soon as possible.

Screening experience teaches us that for large scale screening by a spraying method (we can choose of several approaches) or deployment of infected corn supplied with mist irrigation is the most effective. In this way both Type 1 and Type 2 resistance can be identified and also resistance to kernel infection and DON can be screened. It is suggested to use different resistance sources at the same time to increase efficacy of the breeding work and increase genetic variability in the resistant materials.

We have to evaluate or adapt

Table 2. FHB resistance of genotypes originating from different breeding approaches, 2003

Plot No.	Genotype	FHB %	FDK %	DON ppm	Rel. yield %
	Resistance sources and their progenies	12.0	19.4	9.1	64.0
	Genotypes from WW crosses	26.5	48.8	26.9	44.6
	Cultivars from non FHB programs	35.8	48.1	34.6	31.0
	Popular susceptible control cultivars	55.23	65.78	75.28	29.67

breeding technologies that allow effective screening of segregating populations. They differ in efficacy, exactness, but all make possible large scale screening in these populations. This is even more important as effect of smaller and medium effective QTLs cannot be forecasted exactly. Therefore the real resistance differences can be identified only in the nursery. As breeding is a continuous work, misidentification of the resistance can be improved in the next generation when susceptible plants have lower infection value (escape or other reasons). When the case is the opposite, e. g. moderate resistant plants with high FHB values (for example longer mist irrigation for early genotypes) can be discarded and lost. However, to determine resistance differences between genotype for cultivars and advanced lines needs more careful work with more isolates and replications.

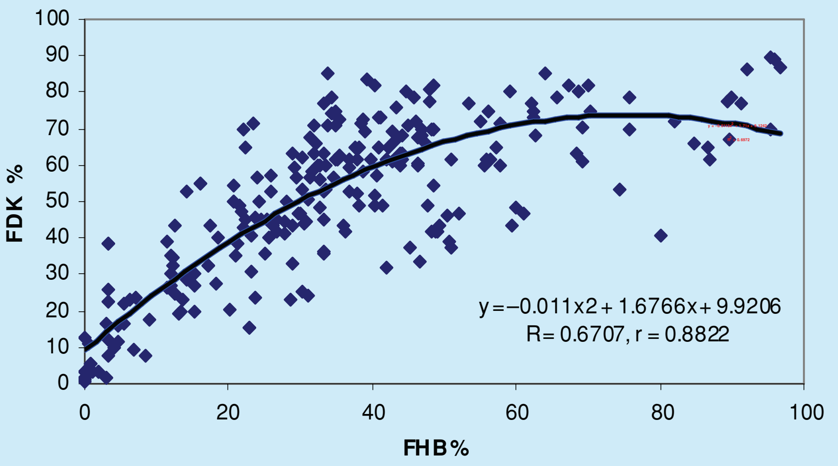

Figure 1. *Relationship between FHB and FDK at 237 wheat genotypes, 2002*

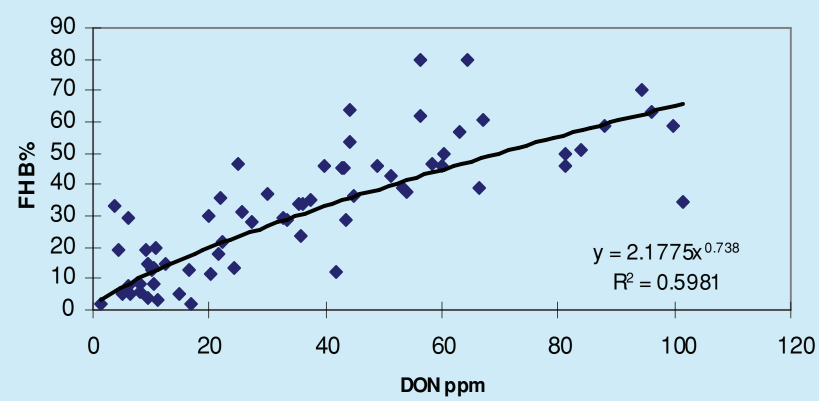

Figure 2. *Regression for FHB and DON, 2003*

Acknowledgements

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Maize Breeding at the Cereal Research Non-Profit Company, Szeged

The Cereal Research Non-Profit Company, considering its legal predecessor as well, has been engaged in plant breeding since 1924. Its early history was marked by intensive research in soil-amelioration, the results of which had a very significant impact on domestic agriculture, and became known to institutions and universities across the border as well.

Maize breeding work began at the research institute in the early 1930's, and it soon resulted in the high-yielding yellow dent maize variety Szegedi Sárga (Szegedi Yellow) (1951), which had an important role in the Hungarian maize production, especially in that of the Hungarian South Lowland.

The second period in maize breeding covered the 1950-1960's. Research focused on and resulted in developing inbred hybrids, among which the dent inbred hybrid Szegedi DC 624 is worth mentioning. Breeding of early types of maize for silage began during the same period, and that genetic base was incorporated into that of the maize breeding work already conducted in co-operation between Keszthely-Martonvásár and Bernburg (Cereal Research Institute), respectively.

The third, still ongoing period in maize breeding, which set off in the early 1970's, had to face radical changes in the economic and social conditions originating from the last major reorganisation in research profiles. In the sense of a governmental decision, parallel to the Agricultural Research Institute, Martonvásár of the Hungarian Academy of Sciences, the research institute in Szeged, among the research institutions of the Ministry, was assigned as the centre, or to be more exact, almost the only basis of research for breeding cereals and maize in Hungary. (The other research institution of the Ministry, where maize breeding was conducted to a more moderate extent for several decades, was the Research Institute for Irrigation in Szarvas.)

The latter period of maize breeding was full of notable and very significant events.

In the early 1970's research workers taking part in maize breeding at the research institutes of the Ministry of Agriculture or at the domestic agricultural universities did not have a chance to visit the USA. (Professor Andor Bálint of Gödöllő as the first of such domestic experts could pay a visit to that country only in 1974. Just think of it: leading maize breeders of four Yugoslavian institutes – Zemun Polje, Novi Sad, Osijek and Zagreb – had a chance to spend a full year at the prominent US universities in the late forties.) This is why the maize breeders in Szeged were highly interested in intensifying the co-operation between the Agricultural University Keszthely and the relevant Faculty and Plant Breeding Institute of University Zagreb, respectively, for maize breeding and variety introduction launched in 1967. The intense collaboration soon became fruitful, because a Bc hybrid (with US public lines as parental components) showed outstanding results among the medium and mid-late maturing maize hybrids grown in Hungary at that time. (The complete assortment of public lines originating from the USA was available for Zagreb University, and that genetic base included the majority of parental components used in the temperate zone, especially by US and French private breeding companies extremely successful at that time.) Thus, we managed to join the international main stream of maize breeding indirectly through Zagreb from 1971 onwards, which enabled us to enter the market with a series of new competitive registered Szegedi maize hybrids, just to mention Szegedi MSC 606 (1978) with A632 and W64A in it.

The most important plant production systems such as CPS, at present IKR, KSZE, KITE and

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BKR were founded in the early 1970's, and they had access to the most modern western techniques for nutrient supply and weed control, respectively, and made a great step forward in mechanisation of plant production by using the most up-to-date machinery (John Deer, Claas, IHC etc.). It soon became obvious that such maize hybrids had to be developed, which met the demands of the new maize production technologies **disregarding of their crossing types (SC, TC or DC), origin and seed price category.** (A fundamental change took place in the variety policy of the Ministry of Agriculture at that time. Regardless of the origin of country, institutions or companies, all hybrids bred for temperate zone were allowed to be tested in the official variety testing system, and if registered, they became free for marketing. To phrase it in another way, in the case of maize and sunflower varieties, the fundamental change in the **system** preceded 20 years **that of 1989/90**.)

According to the principles followed consequently in our international joint programs, a co-operation could commence between the leading maize breeding company in the world, the Pioneer Hi-bred International, Inc. and our institute in 1974, which lasted practically for two decades, having its termination in perfect agreement in 1993. Within the framework of that co-operation, the Pioneer maize hybrids most suitable to our domestic conditions were introduced in Hungary, joint hybrids were developed both for the domestic market and exportation, and the parent seed of hybrids was multiplied and maintained by us in Hungary. In addition, the technology of hybrid seed production was worked out, and a team was formed for advisory service and control.

The other co-operation, which I have already referred to above, evolved between the research institute in Szeged and its counterpart in Bernburg, and it became extremely intensive during the same period. The results were so encouraging that we can write about them only with modest pride. The breeding efforts resulted in two leading joint maize hybrids for silage in Europe (BEKE TC 270 and BEKE DC 246), the annual seed sale records of which were preceded only by the French hybrid Lg 11 in 1970's, and by Dea SC of US origin in 1980's.

The rank of characteristics was changing with utilisation, that is, whether the hybrid in question was a grain or silage maize, for the Hungarian or foreign markets.

As regards grain hybrids, breeding concentrated on increasing the yield per hectare to meet the demand for modern hybrids, parallel to the improvement of stalk and root strength, helping minimize harvest losses. The former primary goal, to increase the yield per individual plant was substituted by higher plant population. Grains reaching the black layer stage before frosts were the guarantee for the safe and reliable harvestibility of grain yield, while fast dry-down rate in the next ripening stage saved the costs of drying, which, of course, could not be eliminated entirely. (Just to remind you, that was the time of the first oil crisis.) It is well-known that the proper ripening is the precondition of good quality feed, and at that time the majority of grain product was exported from Hungary first of all in the form of meat products.

In case of silage maize hybrids, both for the domestic and foreign markets, priority was given to improving total dry-matter content, an essential characteristic to meet the needs of making good quality silage. Breeding of **considerably earlier hybrids** was the key tool that the silage hybrids could attain the silage ripening stage. Grain percentage had to be improved significantly within the total dry-matter content, not to forget the further improvement of digestibility and palatability.

The continuous efforts to adapt our maize breeding program to the recent requirements and tendencies were accompanied by activities in other essential fields, like the technology for maize production and seed production.

Firstly, the production technology for maize was up-dated annually, and covered many aspects of production: nutrient demand and utilisation, susceptibility to herbicides, drought tolerance, water utilisation, ideal population density in relation to variety and soil properties. In addition, it gave practical information to variety specific production technology, and was made available for farmers.

Secondly, the general and variety specific seed production technology was worked out. Our institution had a team for extension service to control the seed production on more than ten thousand hectares yearly and to protect our rights as variety owner and representative, respectively. Our institution had a decisive role and responsibility in hybrid maize seed production till the early 1990's, and the results proved that our colleagues coped with these tasks successfully.

The goals of researches, and within that, those of maize breeding, have undergone only slight changes to date. But the shift in the maturity of recently and earlier marketed hybrids has been considerable. Gradual prominence was given to earlier hybrids during the past three decades. The outcome was that maize hybrids belonging to FAO 300–400 maturity groups became dominant

Table 1. Valuable marketed maize hybrids of Cereal Research Non-Profit Company, Szeged

Hybrid	Maturity	Recommended as	Optimal population 1000 plants/ha for		Test weight
			grain	silage	
Sarolta	FAO 290	grain	60–70	–	76,9
SZE 269	FAO 304	grain, grits	60–70	–	77,0
Szegedi SC 352	FAO 340	grain	55–70	–	74,1
Bella	FAO 380	grain/silage	55–65	65–70	77,3
Szegedi TC 367	FAO 380	grain	55–65	–	76,7
Kenéz	FAO 410	grain	55–65	–	71,9

among commercial hybrids. Trial results, as well as farm experiences have proved that the most profitable hybrids at present belong to the following maturity groups: late FAO 200, FAO 300, early, medium, and mid-late FAO 400.

Maize breeding is carried out at our institution currently by a smaller but very enthusiastic team. The most important goal is to develop early hybrids with high performance by using the tools of conventional breeding. Improved yield per individual plant was put again at the core and became a more essential breeding aspect than it had been in the past three decades, owing to objective changes in nutrient supply. The emphasis has recently shifted to characteristics like adaptability to broad environmental conditions and high yields even at lower plant densities. Modern hybrids, besides tolerating stress conditions, have to respond to favourable climatic and high-input conditions, such as optimal nutrient supply, irrigation, proper weed control, with plus yield.

While US maize hybrids were, ours were not assessed for an important characteristic, the test weight in the past. That characteristic came into the foreground because of the changes both in agricultural policies and the quality requirements of maize trade, and in particular because of the reform of EU's maize intervention system. Analyses reflect that the majority of our maize hybrids belong to the category of hybrids with superior test weights.

Nowadays maize is grown not only as feed or food, but also as a potential source of bioenergy. In this respect either its grain or the whole plant is utilised. Hybrids for this special purpose can be improved by variety specific breeding. The grain composition can differ in the ratio of germ and floury endosperm, moreover, the separated grain components may have different suitability for processing and fermentation, and may vary in water absorption capacity etc.

It is needless to say, that we have ongoing researches in maize biotechnology in co-operation with the Biological Centre of HAS (Szeged) and Western European institutions, the result of which support the conventional breeding.

Mention should be made of phytopathological researches with emphasis on resistance breeding to Fusarium species and viruses. The screening of early generations and selfed populations in the early (S_0–S_3) stages of breeding can be efficient in breeding for disease resistance.

We will be able to face the challenges of agriculture in the near future only by improving the adaptability of our hybrids. To be competitive on the market, our breeding should be more complex covering maize hybrids for specific fodder and industrial purposes, the latter ones grown mainly as renewable energy resources.

To date we can offer 17 marketed hybrids to farmers. The currently most perspective hybrids of our institution are listed in *Table 1*. The value of these hybrids has been confirmed by farm data. You may turn to our colleagues to get detailed information about the hybrids.

We hope that the past and present results of our institution in maize breeding, and its expertise

Lehota, J., Horváth Á., Fürediné, Kovács, A.

Market opportunities for organic food in Hungary

Summary

Organic farming entered West European markets based on consumer demands for healthy food of adequate technological quality. The search for growers who can satisfy the demand has been going on till today. Hungarian organic farming, too, has come into being by the export opportunities arising from this circumstance. The enlargement of the portfolio has however moved in the direction of the premium, convenience and exotic products and the purchase of organic ingredients has begun to focus on the objective of finding the cheapest resources. As a result, demands for the products (cereals, protein and industrial crops) of Hungarian organic farmers have suffered a major setback. The acquisition of the Hungarian market began as a natural response to the saturation of the West European markets. On the other hand, it is doubtful whether Hungarian consumers will be able to absorb the organic food products of Hungarian farmers who are loosing ground on the Western market, while the approximately 15 000 consumers constituting the segment are seen as an attractive market both by the western farmers producing premium organic food products and are in possession of considerable expertise and by the East European rivals who have built up substantial infrastructure for the mass manufacturing of cheap organic products. This study intends to present the results of our research carried out over the past years, as well as a comparative analysis of the findings in the international literature in order to highlight the major tendencies determining the demand for organic food.

Key words: consumer attitude, organic food, marketing

Development of organic food market in Hungary

In Hungary organic food production began in the 1980s. Export opportunities to West European markets offered an excellent business opportunity for organic farmers and for exporting companies. The sector showed dynamic development until 2004: in 1980 only 15 certified farms and 1000 hectares of land under organic cultivation were registered in Hungary, while by 2004 t 1420 farms were engaged in production on 128 690 hectares. This was equivalent to an increase of 12–20% in the acreage under organic cultivation. In 2005, however, this favourable tendency suffered a setback as both the area of land under organic cultivation (about 123 000 hectares) and the number of producing farms (about 1400) had a decline (Biokontroll 2005, Piac és Profit 2006).

The structure of production has also changed significantly over the past decades, as earlier organic food ingredients and cereals were most commonly produced with the objective of meeting the export market demands, nowadays a more balanced and more diversified structure of production can be encountered. In 2005, already 156 farms were active in raising a stock of a total of 15673 standard animals and the proportion of the vegetable, food and vine growing areas amounted to 3.3% of the land under organic cultivation.

The decline of the national organic farming can be attributed to diminished export opportunities. Until the early 2000s 90–95% of the organic food produced were exported to West European countries (Switzerland, Germany, Netherlands and Austria). Experts estimate this proportion to constitute only 65–70% nowadays. The reason for the diminished of the export possibilities is the saturation of the European Union markets. Rivals from Argentina, New Zealand, Australia, Chile, China, Kazakhstan, Ukraine, Bulgaria and Romania dump cheap organic ingredients onto the markets and also the subsidy system of the importing countries for the encouragement of the shift of production has also proved efficient, leading to a significantly increased organic food production at national level.

Due to declining sales opportunities abroad and increasing demand at home, it has become necessary to promote the Hungarian processing industry and commerce. In 1998 only 19 enterprises were engaged in organic food processing. In 2005 their number was already 286.

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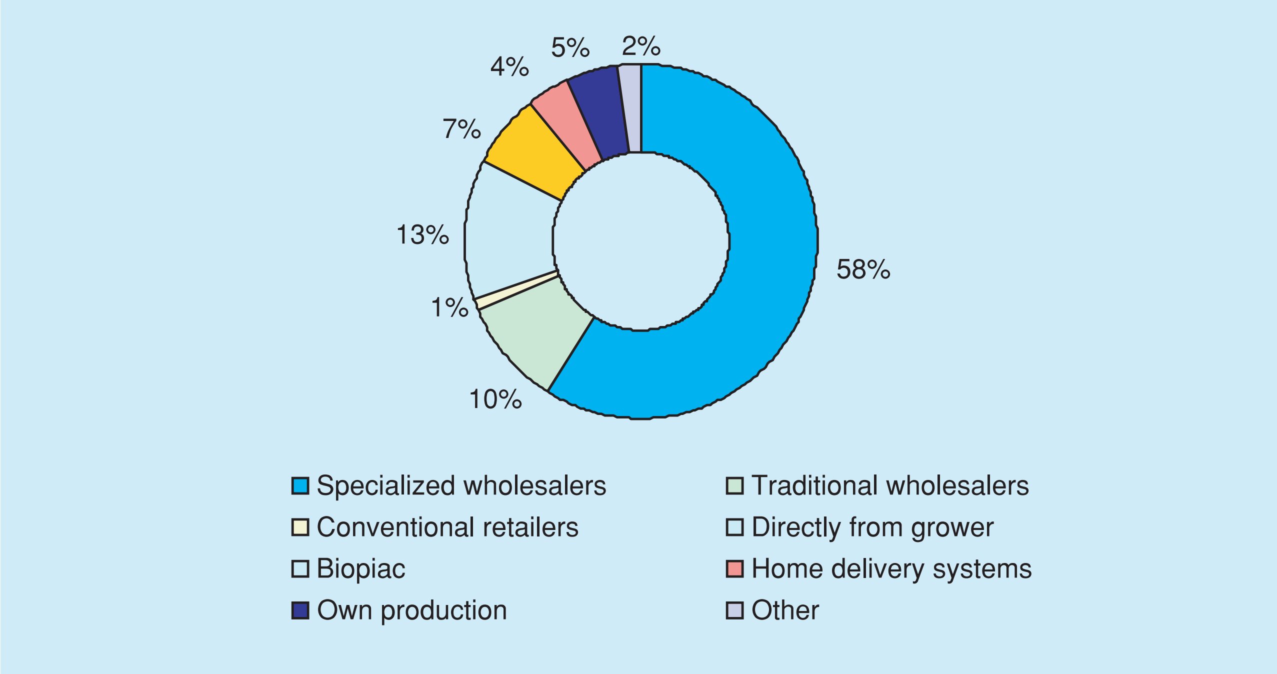

Figure 1. *Sources of supply of organic shops. Source: own research, expert interviews 2005, n=77*

(Biokontroll 2005). While in the earlier period manufacturing typically involved cereal products and almost exclusively dry food items, nowadays a great variety of food is produced in the national factories, including foodstuffs of animal origin and fresh food as well. The primary channel of the sale of fresh products is the organic market, where 80–90 growers offer their products in the main season and 60–70 ones in winter. (A daily trade of 10–20 million HUF[1] is achieved on the market in Csörsz street in Budapest which is open only on Saturdays.) (Batka 2006) Hungarian manufacturers, however, have to face strong competition both in organic shops and in conventional commercial channels.

According to former surveys (Szente 2005) organic shops had typically been opened in order to satisfy the requirements of the segment aiming to consume chemical free vegetarian products. During the summer of 2005 expert interviews (n=77) were made with the managers of the shops supplying products for the consumers dedicated to leading a healthy lifestyle, organic shops, nature's pharmacy shops, reform houses collectively called as healthy food stores in the English literature. When creating the sample we found that the distribution of the shops was associated with the economic development: a greater number was opened in the capital, in the county Pest and in the more developed regions and bigger towns. 53% of the shops operated in premises of under 40 m^2 and their annual turnover was under 10 million HUF. According to our results, organic products on average constituted only 43% of their choice and only 5% of the shops had an assortment consisting 90% of organic products or over. Organic shops are characterized by the dominance of dry goods. The dry goods portfolio which is easier to store and to move and is available in a wider range constitutes an average of 75% of foodstuffs sold. Only one fourth of the organic shops offers the same amount of fresh goods as dry goods. The portfolio of the shops come from specialized wholesalers and fresh products are procured from organic markets. Approximately 20% of the organic products go onto the shop shelves from own production or directly from the grower. A significant part of the choice, instead, comes from abroad. While earlier the missing Hungarian products used to be substituted with premium products from West Europe, nowadays the products of the cheaper East European rivals come onto the shelves in an ever greater number.

A considerable part of the products sold on the Hungarian market are import products which come from the Netherlands, Germany, Austria, the Czech Republic, Slovakia, Romania or the Ukraine (often produced from ingredients exported from Hungary). Hungary's accession to the EU in 2004 has facilitated organic food imports which has led to a wider product range most-

[1]Official middle price of the Hungarian National Bank on 13. 10. 2006: 1 EUR = 265.74 HUF

ly in the multinational chain stores. Previously, hypermarkets and supermarkets ascribed their difficulties in widening the product range to poor sources of supply (Kovács 2003, AMC 2003) and included only few Hungarian enterprises on their supplier list (Piszke Ökopékség, Zöldfarm Milk Farm, Biopont Kft., Pick Salami Factory). Following the opening up of the borders, however, they have significantly broadened their product range. For example, the Austrian owned Spar, Interspar and Kaisers stores have store brand organic products (Naturpur) in every product category which are manufactured in Austria. In the case of this very store chain organic products of Hungarian manufacturers are met only in a few product groups. In other stores, e.g. the British-owned TESCO, where Hungarian and foreign products show a more balanced proportion, the intention is to offer a cheaper alternative from import products for health conscious consumers.

Table 1: *Advantages of shopping in organic shops and in hyper and supermarkets according to customers of organic shops*

Advantages of shopping in organic shops	Advantages of shopping large scale grocery stores
• Safety • Pleasant atmosphere • Product quality • Composition of choice	• Favourable prices • Fastness and comfortableness • Freshness of product • Wide choice

Source: own research 2005, n=697

Conventional commerce, on the other hand, still treats the group of health conscious consumers only as a minor market segment and provides space for healthy, dietary, reform or organic food only in a single corner or on a single shelf of the stores. A survey which we carried out in 2004 revealed that the organic food business of the conventional shops could be considered very low, with a maximum of 50–200 organic products available offering an unstructured and incomplete assortment of these quality categories (Horváth–Kovács, 2004). In international comparison, however, it can be seen that the multinational business units apply the same practice in Hungary as 10 years ago in their mother countries and probably, in response to increasing consumer demand, they will introduce the portfolio widening strategy as already proven to be successful in the mother country. (Kovács–Richter 2005) According to estimates by ZMP (2004) the large scale shops of the conventional

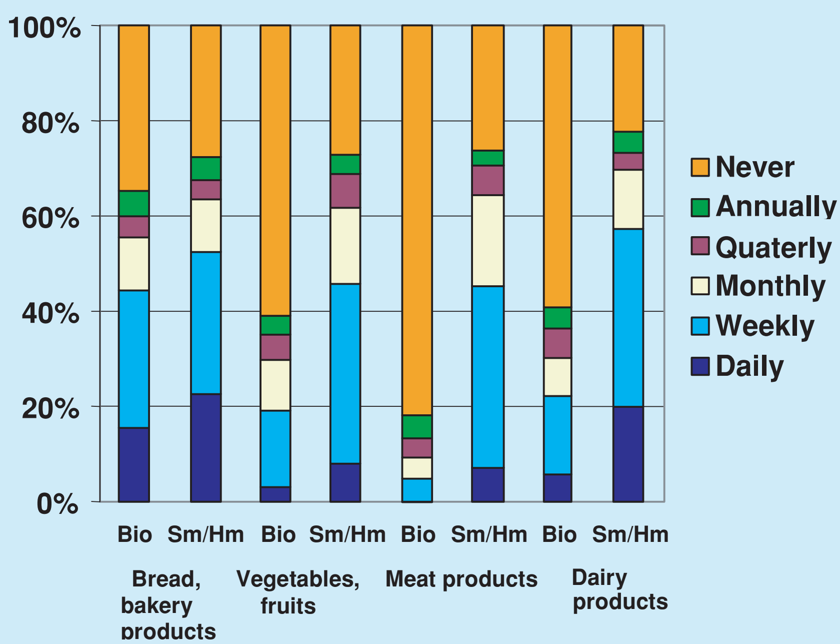

Figure 2. *Frequency of purchase of food items bought for daily use at organic shops and in supermarkets – based on investigation among customers of organic shops. Source: own research 2005, n=697*

Table 2: *Motivations behind organic food consumption among customers interviewed at different shopping places (in percentage of answers)*

Motivation	Customers of organic shops 2002[1]	Customers of supermarkets 2002[2]	Customers of supermarkets 2006[3]	Customers of organic markets 2006[3]
Health reasons	73%	67%	84%	97%
Supporter of healthy eating	60%	24%	46%	89%
Vegetarian	36%	1%	16%	17%
Upon doctor's recommendation	4%	17%	21%	9%
Upon recommendation of a natural therapist	4%	6%	15%	4%

Source: [1]Gyöngyösi, 2002, n=200, [2]Kovács 2002, n=100, [3]own research ordered by Hungarian Bioculture Association 2006, $nö_p$=109, ns_{zm}=134

retail trade (hypermarkets and supermarkets) have a 50–60% share of the Hungarian organic product turnover. The number of organic shops is estimated to 200–300. They account for 30–40% of the business. The channels of direct marketing (sales at farms, home delivery systems and organic markets) have a share of 1–5%.

As can be seen, Hungarian organic farmers have to do well in a strong competition both on the national and on the international market. For the further development of the sector it is essential to find out to which extent Hungarian consumers are open to Hungarian organic food and which means could be suitable for increasing their demand.

Organic food consumption

The national organic food consumption shows a rising tendency though still rather low. In 2002 it constituted 0.05% of total food consumption. (Oszoli 2002) According to expert estimates, the group of organic food shoppers has grown to 150 000. (Batka, 2006) Organic products, on the other hand, will probably never become mass products, but will satisfy the demands of a market gap. (Lehota et al.1997, Lakner-Sarudi 2004) Organic food is primarily demanded by middle aged women with higher education and above-average income level living in towns. Families with small children also represent significant potential, as well as elderly people intent on maintaining their health and young people anxious about their beauty and condition. Organic food can also be encountered as a prestige product which increases the motivation to buy in customers aspiring

Table 3: *Hazard levels associated with perceived food risks among Hungarian customers interviewed at different shopping places*

Risk source	Customers of organic shops 2002[1]	Customers of supermarkets 2002[2]	Customers of supermarkets 2006[3]	Customers of organic markets 2006[3]
Pesticide residues	4.68	4.12	4.21	4.92
Preservation with onizing radiation	4.46	4.36	3.89	4.80
Genetically modified organisms	n.a.	4.18	4.04	4.79
Artificial additives	4.48	3.65	4.04	4.84
High sugar content	3.92	3.04	3.86	4.83
High fat content	4.76	3.44	3.97	4.80

1=not dangerous at all, 5=very dangerous, Source: [1]Gyöngyösi, 2002, n=200, [2]Kovács 2002, n=100, [3]own research ordered by Hungarian Bioculture Association 2006, $n_{öp}$=109, n_{szm}=134

Table 4: *Requirements for food items among Hungarian customers interviewed at different shopping places*

Important food characteristics from health considerations	Total population[1] 2003	Customers of supermarkets[2] 2006	Customers of organic shops[3] 2005	Customers of organic markets[2] 2006
Functional quality (low carbohydrate fat and energy content)	30–40%	46–53%	55–60%	82–85%
Technological quality (no chemicals and artificial materials used in the process of production)	54–58%	57–60%	82–85%	95–96%
Organic food	26%	33%	74%	80%

Source: [1]Gfk. Hungarian, 2003, n=1000, [2]own research ordered by Hungarian Bioculture Association 2006, $n_{öp}$=109, n_{szm}=134, [3]own research 2005, n=697

to a higher image.

West European studies suggest that the differentiation of commercial channels is accompanied by the differentiation of the group of organic product buyers. Schaer 2001, Schäfer–Madsen–Walk 2001, Richter 2003, Bio Plus AG 2005 found that customers tended to show a higher level of trust towards the special commercial channels than towards the conventional trade units. Organic shops are given preference because of the pleasant atmosphere, the majority of the organic food, however, is bought from the big conventional shops for the reason of saving money and time. Based on the results from our questionnaire survey conducted among the customers of Hungarian organic shops in the summer of 2005, it can be seen that this phenomenon is already evident in Hungary, too. The results of the survey also reveal that the customers see no significant difference in product portfolio composition depending on the place of origin, as they think to find the products of foreign manufacturers in greater numbers in both types of shops.

According to Szente (2005) the most demanded organic products in Hungary are bakery products, fruits and vegetables. Customers come in 80% of the organic shops primarily for food products but are also disposed to buy food supplements and herbs. FMCG products however are still principally bought at conventional commercial units. It can be seen that organic shops could become competitive mostly in those product segments which are characterized by a poor choice in the conventional retail units as only three product groups, i.e. teas, herbs and food supplements are bought more frequently at organic shops than in hyper and supermarkets.

The consumption of organic food is a means of increasing individual advantages in the countries with a developing organic product market, similar to Hungary. (Richter–Kovács 2005) The national investigations into the motivations behind the consumption of organic food unanimously revealed that Hungarian people are motivated to opt for this product group for the sake of preserving their wellness and health. The protection of the environment, organic farming and the common advantages resulting from the subsidization of Hungarian growers are less important for them than for German, Austrian or Swiss consumers.

This is due to the fact that the consumption of organic food offers solution to reduce risks perceived in connection with food items. Szakály–Szente–Szigeti (2005) conclude that 43.5% of Hungarian consumers find the E numbers as markedly dangerous, 31.5% the stabilizers and the colouring agents and 27.0% the preservatives.

The results of the 1996 and 2002 consumer interviews of our institution indicate that the consumers of organic products show above average sensibility to risks arising from water and air pollution, from food items with pesticide residues and artificial preservatives or subjected to irradiation (Lehota, 1996, Kovács, 2003) and it can also be seen that the customers of organic shops and organic markets are above average informed about the risks from conventional nutrition (Gyöngyösi, 2002, Fürediné Kovács–Gelencsér, 2006)

Investigations into food consumer behaviour of the last years (Horváth 1996, Gfk 2003, Szente 2005, Lajos 2005) showed that Hungarian consumers consider high quality to be the most important criterion in the choice of food

Table 5: *Characteristics attributed to organic food among Hungarian customers interviewed at different shopping places*

Characteristic	Supermarket 2002[1]	Supermarket 2006[2]	Organic market 2006[2]
Health protective effect	78.0	64.2	98.2
Grown without using any synthetic pesticides	76.0	73.9	95.46
Produced in a environmentally friendly way	49.0	80.6	91.8
Produced in accordance with an objective system of prescriptions	35.0	51.5	68.8
Production is regularly inspected by an independent organization	37.0	58.2	93.6

Source: [1]Kovács 2002, n=100, [2]own research ordered by Hungarian Bioculture Association 2006, $n_{öp}$=109, n_{szm}=134

which is coupled on the one hand with the price-value ratio and on the other hand with health considerations. In *Table 4* we provide a summary illustration of the proportions of the consumers among the customers of the individual shopping places who consider the influence on health as an important factor when they make food purchasing decisions.

It can be seen from *Table 4* that the consumers who in their choice of shopping place accept the additional costs (time, energy, money) accompanying shopping in safer shopping places put also higher emphasis on food safety considerations. The most sensitive decision makers and the most conscious organic food buyers seem to be the customers of the organic markets, but also among the customers of the organic shops the proportion of health conscious customers is at least twice as much as in a supermarket.

The obstacles to buying organic food are defined by the literature as follow: doubt in authenticity, aesthetical shortcomings, short storability, difficulty of acquisition and high price.

The doubt in authenticity is correlated with the poorly informed state of consumers. Consumers do not have a clear knowledge of the fact that those food items can be called organic food that have been produced in accordance with an objective system of prescriptions and that are regularly inspected and certified by an independent organization *(See Table 5)*. A further sign of profound ignorance that a significant part of the customers, even the 92% of the regular organic market customers, think that organic food is exclusively of plant origin.

This ignorance is also manifested in the fact that only a small percent of customers look up the meaning of the product code prescribed by law and the trade-mark of the Hungarian Bioculture Association, as well as those of the certifying organizations are known by only less than one-fourth of the customers. For the customers of the organic markets it is the logo of the inspecting organizations that is an important point of reference, while in the shops it is the label on the package or the information from shop assistant that govern choices. These, on the other hand, are often poor or misleading.

Western European studies (Grüner Bericht, 2000, Wagner, 2000, Schade et al. 1999) establish the optimal extra price to be 30%. The data collection of Richter (2004) however reveals that the extra prices of the individual product groups range between 20–250% on the international markets due to the particularities of demand. According to the survey of Mokry (2002) the customers of the Hungarian organic market regard the 25–27% extra price as being acceptable, while in reality they pay an extra charge of 40–70%. According to the results of our survey (2006) carried out for the Hungarian Bioculture Association the customers of the organic markets, on average, estimate organic food to be 62% (deviation 62.6) more expensive than traditional food, while the customers of the supermarkets, on average, estimate it to be 79.4% (deviation: 85.8). The most common values in connection with the perceived extra price ranged between 26–50%. 70–80% of the customers of the Hungarian organic shops consider the price of organic food items as being high, still, due to the acknowledged utilities, the product group is demanded. According to the results of Gyöngyösi (2002) the customers of the organic shops would increase their organic product purchase by 30% in the case of a 10% price decrease.

As a result of the price sensitivity typical of Hungarian customers it is a commonly encountered phenomenon in food commerce that food items of poorer quality and doubtful origin are characterized by a higher demand than safe but more expensive products. It represents a serious threat for the manufacturers of the traditional food items, too, to loose the market because of the massive inflow of the cheap import products from both Western and Eastern Europe. The investigations carried out so far suggest that the products of the Hungarian manufacturers are being bought in preference to the products of the foreign manufacturers, but it can also be seen that generally, the place of origin[2] is not considered to be important in the choice of the product. For example, only 25% of the customers of the organic shops can be classed into the segment of the ethical shoppers who regard the environmental considerations and the Hungarian origin to be more important than other product characteristics. Through our investigations carried out among the customers of organic markets and supermarkets we have managed to highlight that customers think it important that the Hungarian organic products should be distinguished in an unequivocal manner, but will opt for them only if they have at least as high a quality as the concurrent products arriving from abroad.

Conclusions and recommendations

Market enlargement activities for organic products are advised to be organized in the first place in connection with the health trend since the product group is bought principally as an alternative to reduce the hazards perceived in connection with traditional foodstuffs. The group of consumers dedicated to healthy eating make food safety derive substantially from technological quality, i.e. from the state of being free from artificial additives and chemicals. On the other hand, the place of origin of the food products have little influence on the shopping choice of Hungarian customers and therefore they will choose Hungarian organic products only if they do not see a significant difference in the price and quality of the latter as compared to the products of foreign manufacturers. This makes the situation of the manufacturers of processed and dry food particularly difficult as in these product categories, without exception, the products of the rivals with several decades of expertise and settled for a high volume production appear in an ever greater number on the Hungarian market. They can have a significant supplementary or substitutive position both in the choice of organic shops and super and hypermarkets.

The lack of basic information in connection with organic food is a serious problem in our country, as well as the resulting distrust. It would be necessary to carry out a dissemination activity, concentrating on the construction of trustworthiness, which would have its central elements consisting in an objective system of requirements providing the basis for organic production and in regular inspection and in certification. The provision of explicit information for customers requires that Hungarian organic food items should be marked in an unequivocal and distinct manner. On the international markets, in accordance with the basic philosophy of organic production there are efforts to supply regional or national growers' products to consumers. This can also be supported by the fact that West European consumers have more confidence in the growers that are closer to them. Besides the emotional aspects, traceability and the subsidization of the national economy are also central issues.

From all this, it can be seen that if market actors and the responsible organizations of the community marketing do not pay sufficient attention to building up the trust in the Hungarian organic products and do not elaborate such programmes as are specifically focused on making Hungarian manufactured organic food more popular, the increasing organic food demand of the Hungarian customers will not solve the marketing problems of the products of the Hungarian organic farmers. Preferably, the focus of the promotional activity should be the Hungarian traditions, the common values, the adaptation of the international standards, as well as the advantages coming from low dis-

[2]No previous surveys were available whether the Hungarian consumers made any distinction between the import products coming from West and those from East.

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