

RESEARCH, BREEDING, VARIETY TESTING AND SEED PRODUCTION OF FIELD CROPS IN THE CZECH REPUBLIC

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The last 15 years in the Czech Republic have been characterized by passing over to the market economy. The majority of Czech agricultural enterprises, breeding stations, seed companies and specialized agricultural research institutes have been privatized or transformed. The development structure in the agriculture manifests the increase in a number of private farmers and decrease in cooperatives and business companies (Ltd., Co. Ltd.). In comparison to the data from the period 2000–2001, private farmers and business companies became a dominant entrepreneurial form. The share of private farmers represents 27.2 % and business companies 44.8 %. Among business companies, joint stock companies (Co. Ltd.) dominate as compared to companies with limited liability (Ltd.). The area of agricultural land cultivated by cooperatives sank under 1 million ha and represents 27 % of total agricultural land. The percentage of agricultural area cultivated by special enterprises (state enterprises, school farms) has fallen and is very low already for a longer period.

The total agricultural production (plant and animal) measured in stable prices was reduced by approximately 36 % in comparison with that in the period from 1989 to 2002. The main reason was the reduction of farmer's prices. The long-term tendency is the opening of price scissors due to dramatic differences between farmer's prices on the one hand and input prices, particularly of machinery, spare parts, and agrochemicals on the other hand. In spite of presented negative tendencies it is possible to state that real wages in agriculture have increased, nevertheless accompanied by the reduction of employee number.

Varieties, seed and plant property law, variety testing and multiplication. The Czech Republic had been preparing for the membership in the European Union (EU) since 1990. Practically all measures and decisions of the Parliament and Government in the area of the variety testing, seed production were adapted to this goal. Already in the year 1995, the law of 'Varieties, seeds and plant property rights' was approved by the Parliament. In spite of the full compatibility of the law with the regulations in the EU, the law was amended in 1999, 2001 and 2003 as new facts came into existence. The Czech Republic became the member of the International Union for the Protection of Varieties (UPOV) and respects the UPOV laws. Foreign companies in the Czech Republic are represented by the Czech subjects or if appropriate they establish own representation which takes care of variety registration, multiplication and collection of royalties. Variety owners protect their interests by means of the **Cooperative of Variety Owners** which collects the remuneration fees from farmers. The Czech Republic is prepared for the further technological development, because there is the interest, particularly of seed companies, to increase the trade with the seeds of the genetically modified organisms (GMO). The trade with GMO is adjusted by the GMO law.

The seed producers in the Czech Republic are represented by 430 registered private subjects. In addition, there are 250 subjects for the area of fruit and ornamental plants and hops. Yearly extent of seed production is estimated at the level of approximately 6 milliard Czech Republic (200 million EUR).

Breeding has a long tradition as Mendel and Proskowetz started the systematic genetic studies and breeding in the second half of the 19th century. At present, many companies are dealing with breeding and seed production of field, fruit, vegetable, hop and ornamental crops. In the territory of the Czech Republic, there are as well as several breeding stations in the property of international breeding and seed companies. The representative body of all breeders and seed producers is the Czech Seed Trade Association (CSTA). This association supports above all increase in the private sector responsibility in official negotiations in the area of the seed certifying. Principal purpose of the seed sector is to offer the seeds of the highest quality at reasonable prices to agricultural producers. The CSTA negotiates for instance the national support for purchase of the certified seeds for the stabilization of the quality of seed production. Particularly, it concerned wheat and barley

because of seedborne diseases. Seed exchange reached 60% in wheat and 50 % in barley in 2003. The multiplication area of the individual crops varied in the last years (1998–2003), although it sank clearly in comparison with the year 1994 (Table 1). The royalties in the Czech Republic are lower (around 50 %) in comparison with Germany and France. For example, wheat royalties reach 2.00 to 4.00 EUR for each 100 kg of seed in the Czech Republic. In Germany, the royalties are 4.31–6.31 EUR and in France 5.05–6.60 EUR.

Nevertheless, there is still very high interest of the foreign companies to penetrate to the Czech market. Table 2 manifests the development in the multiplication of foreign and Czech varieties as for the most important varieties of cereals (wheat and barley). Comparing the years 2000 and 2003, there is a quite clear increase in the multiplication areas with foreign varieties of all cereals, particularly of spring and winter barley. The further development will

Table 1

Development of multiplication area [ha] of most important field crops

Cereal crop	Years						
	1994	1998	1999	2000	2001	2002	2003
Winter wheat	54180	45111	36652	31916	34536	40379	41441
Spring barley	30667	25517	18426	16886	20656	22615	23841
Winter barley	11623	9211	7516	5137	5298	8798	9474
Rye	4872	3615	1687	1208	1185	1272	1690
Peas	10497	7691	5586	4572	5122	5052	3909
Winter rape	1298	1512	1403	1079	1012	1379	1209

Table 2

Share of foreign and Czech cultivars in the multiplication area of cereals in the Czech Republic (2000–2003)

Cereal crop	Years	Area of cultivation, %		Share of registered Czech varieties, %	
		Czech varieties	Foreign varieties	Czech varieties	Foreign varieties
Winter wheat	2000	70.4	29.6	49.1	
	2003	42.2	57.8	42.2	
Spring wheat	2000	73.4	26.6	85.7	
	2003	46.6	53.4	53.8	
Spring barley	2000	55.5	44.5	56.9	
	2003	27.0	73.0	42.2	
Winter barley	2000	70.0	30.0	35.9	
	2003	25.8	74.2	28.0	

reflect the interests of the processing industry, particularly in malting barley. In spite of the fact that breeding has a long tradition in the Czech Republic, it is more and more difficult to be competitive to the foreign companies, mainly from Germany, France and the Netherlands.

The development of most important crops and the impacts on breeding and seed production.

The total area of agricultural land represents in the Czech Republic 4272810 ha. The acreage of arable land sank after the accession to the EU by approximately 15 % and places 2665713 ha. For many years, the cereals have been dominating crops on arable land (around 60 %). In 2004, winter wheat was cultivated on the area of more than 800 000 ha (Table 3). It shows that among cereals winter cereals strongly dominate on nearly 70 % of the total area of cereal crops. Spring barley dominates among spring cereals, although the surfaces planted with corn rise practically each year. The year 2003/04 provided very high yield of cereals. The yields of the individual cereal crops were about 40 % higher compared to the average of the period 2000–2003. The exception was winter wheat and winter rape. Winter wheat proved very high yield stability in contrast to winter rape because of higher winterhardiness. Winter wheat has manifested even very high yield potential. In the official state trials, varieties Globus (D)

and Meritto (Czech Republic) reached yields higher than 15 t·ha⁻¹. As for spring and winter barley, there were dramatic fluctuations in the period 2000–2004 (Table 4). In 2000, spring barley reached the lowest yield because of drought during the vegetation period. The difference between spring and winter barley was 25 % in favour of winter barley. In 2003, winter barley achieved historically the lowest yield, which was around 22 % lower in comparison to spring barley due to extensive winter kill. The yield fluctuations are not caused by climatic changes only. Comparing the Czech Republic and Germany as for spring barley (Fig. 1) and winter wheat (Fig. 2), one can state that till 1990 the yields were comparable or higher, particularly in spring barley. Since 1990, the differences have

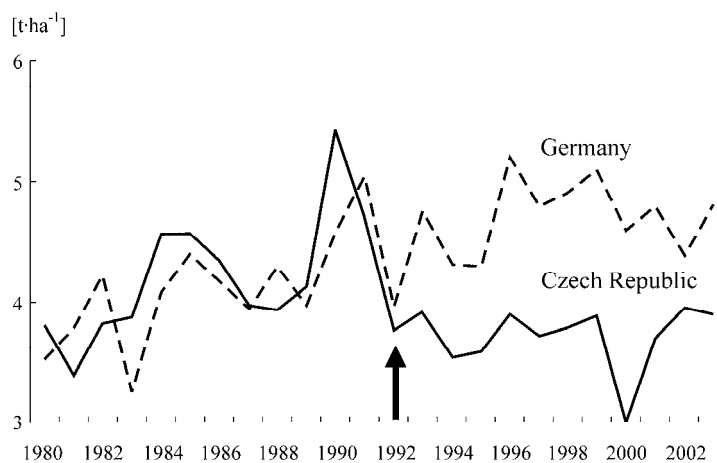


Fig. 1. Comparison of spring barley yields in the Czech Republic and Germany (1980–2003).

Table 3

Comparison of average cereal and winter rape yields in the Czech Republic

Crop	Area of cultivation	Average 1999–2003	2004	Difference	
	1000 ha			t·ha ⁻¹	t·ha ⁻¹
Winter wheat	801	4.57	5.80	1.2	27
Spring wheat	61	3.30	4.80	1.5	45
Winter barley	115	3.82	5.17	1.4	35
Spring barley	353	3.66	5.07	1.4	39
Rye	59	3.60	4.93	1.3	37
Oat	59	2.93	3.98	1.1	36
Triticale	63	3.81	5.11	1.3	34
Winter rape	254	2.39	3.64	1.3	52

Table 4
Development of spring and winter barley area and yield in the period 1974–2004

Year	Winter barley		Spring barley		Difference	
	[1000 ha]	[t·ha ⁻¹]	[1000 ha]	[t·ha ⁻¹]	[t·ha ⁻¹]	[%]
1974	4	3.5	649	3.9	-0.36	-11
1984	123	5.1	469	4.5	0.53	13
1990	243	6.1	339	5.4	0.62	12
1994	185	4.2	495	3.7	0.47	13
1995	195	4.4	370	3.8	0.62	14
1998	187	4.1	393	3.8	0.31	8
2000	142	4.0	354	3.0	1.00	25
2001	157	4.4	338	3.7	0.70	18
2002	141	3.7	345	4.0	-0.30	-6
2003	98	3.1	450	3.9	-0.80	-22
2004	115	4.5	353	4.2	-0.30	7

been increasing very dramatically. One of the main causes is the considerable reduction in fertilization in the Czech Republic. The fertilization is also very low for calcium. Namely spring barley suffers from the reduced soil fertility and a lack of calcium. On the contrary, at the same time the fertilization in Germany was much higher, particularly as for calcium. In spite of that fact, the Czech Republic manifests better situation than the other East and Central European countries.

As for the other crops, dramatic reduction was recorded in the areas planted with sugar beet and potato in the Czech Republic. In contrast, the cultivated areas of winter rape rose very strongly. Due to the global warming, we expect further changes in the structure of oil crops, particularly sunflower. On the contrary, the traditional crop such as pea stagnates because the yields are on the level of 2.5 t·ha⁻¹ and the cultivated areas have declined in the last years. The pea is not economically competitive to cereals and oil crops.

The agricultural research and variety testing. The specialized agricultural research and breeding institutes were privatized in 1994 and the societies with the limited liability were established. These institutes pursue the research with the national support. The research insti-

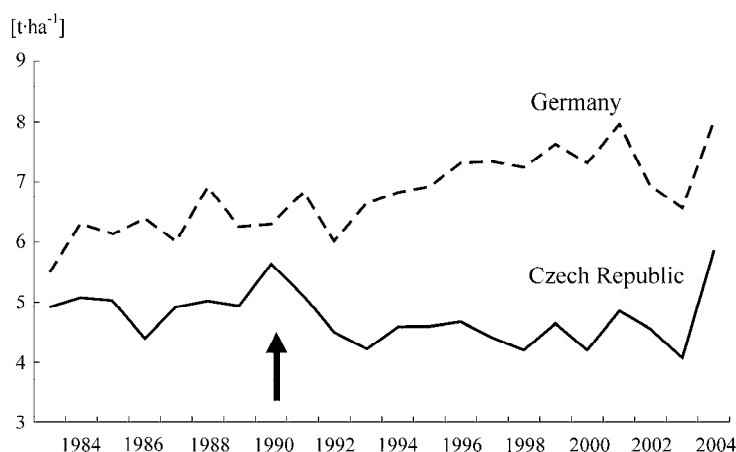


Fig. 2. Comparison of winter wheat yields in the Czech Republic and Germany (1980–2003).

tutes have to participate in the competition, to be successful with research projects and to get the state support in the range from 80 to 100 %. Furthermore, basic and strategic research is financed by the Grant Agency of the Czech Republic or National Agency for the Agricultural Research directly from the national budget. The variety testing is financed and managed by the Ministry of Agriculture.

Winter wheat in the Czech Republic

Assortment of registered varieties of winter wheat. The assortment of the registered varieties comprises 67 winter and 18 spring

wheat *Triticum aestivum* L. varieties (the list valid from 1st October 2004). Only approximately 60 winter wheat and 10 spring wheat varieties are multiplied for farmers. In this assortment, particularly the varieties from Germany, France and the Netherlands have become generally accepted, quite exceptionally the varieties from the other EU states in the last 10 years. The comparison of the years 2000 and 2003 demonstrates the rise of foreign varieties from 29.6 % in 2000 to 57.8 % in 2003 (Table 4). It mostly concerns the varieties with the highest E and A quality such as Ebi, Batis and Ludwig. In 2003, winter wheat experienced the strongest winter kill since 1990. The scores of the winterhardiness lower than 4 are insufficient in years if more severe winter occurs. This disadvantage came to the expression only in the winter 2003. That is why some of the varieties registered in 2003-2005 have not appropriate winterhardiness. Nevertheless, only one Czech variety Meritto with appropriate winterhardiness has been registered in the period 2003–2005.

Market tendency in bread-making and feed wheat. Market prices of bread-making wheat per tone reached 150 EUR in 1997 and 100 EUR in 2002. The current price (2005) is 140 EUR. The prices of bread-making wheat are 10-20 EUR higher than of feed wheat.

Quality characteristics of soft wheat varieties. Wheat quality characteristics are evaluated according to the approved standards that are in accordance with the EU standards. The purchase price of grain is usually assessed not only on the basis of quality, but as well as on

current situation on the market. The purchase of bread-making and biscuit wheat runs according to the approved Czech State Standard 46 1100-2 that determines minimum values required. There were two basic categories of grain quality till 1997: bread-making quality and quality for the other use. After the accession of the Czech Republic to the EU, the methods for grain quality evaluation had to be adapted to the criteria accepted in the EU. Bread-making quality is divided into the three groups (E – elite, A – quality and B – bread quality) (Table 5). The varieties are classified based on detailed analyses and comparison with control varieties by the Central Institute for Supervision and Testing in Agriculture. The criteria can be changed depending on weather conditions of the year. Group C includes wheats that are not acceptable for bread-making purposes. These varieties are usually used for feeding. However, no standards for feeding quality have been set down due to costly and labour-intensive conduct of feeding tests. Particular sections of biscuit wheat (for production of biscuits, waffles, crackers, and others) are not determined by any standard and requirements of the processing industry are included in contracts.

Quality monitoring of winter wheat production in agricultural enterprises. The quality characteristics were investigated at the Institute for the Agricultural Research Kromeriz Ltd. on behalf of the Ministry of Agriculture of the Czech Republic. For the quality determination about 1000 grain samples of soft wheat were provided by agricultural enterprises lo-

Table 5

Minimal quality requirement for including wheat cultivars
in bread-making groups in the Czech Republic

Quality group	E – elite		A – quality		B – bread quality	
	absolute	relative [9–1]	absolute	relative [9–1]	absolute	relative [9–1]
Loaf volume, ml	549	8	513	6	477	4
Protein content, % (N·5.7)	12.6	6	11.8	4	11.1	2
Sedimentation Zeleny test, ml	47	7	33	5	19	3
Hagberg falling number, s	240	6	200	4	160	2
Volume weight, g·l ⁻¹	790	7	780	6	760	4
Water absorption, %	58.7	7	55.5	5	53.9	4

Each quality index was scored at 1 (low) to 9 (high) scale based on visual observation.
Data from Central Institute for Supervising and Testing in Agriculture (2002–2004).

cated under different soil and climatic conditions. The average values from the year 2004 was recorded that 45% of the samples achieved the minimum level in the raw protein content. Nevertheless, the minimum requirement being 11.5 % is considered to be very low from the point of view of many EU countries. Very positive results were obtained for falling number and sedimentation value from the investigation of the quality in 2000–2004.

Monitoring of the fusarium mycotoxins.

Together with monitoring of wheat quality, investigation of the Fusarium mycotoxin deoxynivalenol (DON) in the samples of wheat, spring barley and rye was accomplished in 2000–2004. The limiting values for DON were set down by the Ministry of Agriculture and health service as follows: in grain $2.0 \text{ mg}\cdot\text{kg}^{-1}$, in flour $1.0 \text{ mg}\cdot\text{kg}^{-1}$ and for child nutrition $0.5 \text{ mg}\cdot\text{kg}^{-1}$. According to Sykorova *et al.* (2003), DON average content ranged from $0.14 \text{ mg}\cdot\text{kg}^{-1}$ in 2000 to $0.36 \text{ mg}\cdot\text{kg}^{-1}$ in 2003.

Summary

- Full privatization of agriculture, breeding and seed production was accomplished in the Czech Republic.
- All legal regulations are in conformity with laws and regulations in the EU.
- The national and above all foreign and international companies have large influence on the variety and seed development.
- Seed prices and royalties are about 50% lower in the Czech Republic in comparison with many EU countries, particularly with Germany and France.
- Processing industry strongly influences the variety selection, especially in malting barley.
- The fertilization with N, P, K and Ca nutrients has strongly reduced since 1990 and the negative consequences have begun to express namely in the reduction of yield in all cereals and particularly in spring barley.
- Czech agriculture strongly adjusts the agricultural production to the free-market economy

in all crops, particularly as for the increase in winter rape cultivation. On the contrary, sugar beet and potato exhibited dramatic reduction of cultivation area.

- The global warming positively influenced the increase in the area of sunflower.
- The cultivated area of winter wheat is on the level of 800 000 ha. This surface places 50 % to the cultivated area under cereals and it is characterized by high stability.
- Yields of winter wheat are on the level of 4.5 to $5.5 \text{ t}\cdot\text{ha}^{-1}$ and winter wheat is the most yielding and most yield-stable crop among cereals.
- There are 4 quality categories of wheat – bread-making, biscuit (biscuits, waffles and crackers), spirit and feeding.
- Bread-making wheat is divided into 3 groups (E – elite, A – quality and B – bread quality) and the wheat unacceptable for bread-making is included in group C.
- The varieties with good bread-making quality (E and A) from both the Czech Republic and other EU countries dominate in the assortment.
- Market prices of bread-making wheat reached 150 EUR/tonne in 1997 and 100 EUR/tonne in 2002. The current price in the year 2005 reaches 140 EUR/tonne.
- The monitoring of quality exhibits high quality parameters for falling number and sedimentation value on one side and low protein content on the other side.

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