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Wheat season. The 2006–07 season started with a drier than average autumn, which had a negative effect on the uniformity of emergence and on autumn tillering. The long period of warm weather helped virus vectors to survive, so in many places, especially where emergence was patchy, the stands suffered virus infection. The unusually warm, dry weather continued during the winter and the lack of frost during the winter months meant that the plants developed continuously, without a dormant period. After rainfall in late winter, April again was very dry and from the second half of May, extreme heat damaged the stand. A severe powdery mildew epidemic in spring was terminated by the hot, dry weather. The level of natural leaf rust infection was negligible. The wheat harvest was not disturbed by rain or any other unfavorable conditions, so although the national yield average was lower than usual (3.6 t/ha), the crop was of very good quality.

Breeding.

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Breeding. Three winter wheat cultivars were registered in Hungary in 2007, and the winter wheats Mv Toborzo and Mv Regiment and the winter durum Mv Makaroni were registered in Romania.

Mv Laura (Mv 11-04) is an early maturing, awnless cultivar with good abiotic stress resistance, selected from the cross 'BR918/Ukrainka//Dropia/Ukrainka'. The frost resistance level determined in phytotron tests is very good. Mv Laura has below-average protein content, with excellent gluten quality. The HMW-glutenin composition is 1, 7*+8, 5+10; the LMW composition is c, b, c; and the cultivar does not have T1B·1R. Mv Laura is moderately resistant to powdery mildew, resistant to leaf rust and stem rust, and has good field resistance to yellow rust.

Mv Lucia (Mv 15-04) is a mid-early, hard red cultivar with a high yield level and wide adaptability to very different geographical regions. The head type is awned, plant height is optimal (90-95 cm), and lodging resistance reliable. Mv Lucia has good frost tolerance and winter hardiness. The cultivar was selected from the cross 'Csornoc/Odesskaya 132'. Mv Lucia has acceptable field resistance against powdery mildew and good resistance to leaf rust and good baking quality; the dough strength and stability, especially, are excellent. The HMW-glutenin composition is 2*, 7+9, 5+10 and the LMW is d, b, b.

Mv Zelma (Mv 17-04) was selected from a single cross (C30-2-3-5/Magvas) and was registered as a mid-late maturing bread wheat cultivar. The grain type is HR and the quality is good. One advantage of this new cultivar is that despite the later maturity, it has good yield stability even in hot, dry years. The HMW-glutenin composition is 2*, 7+8, 5+10 and the LMW is c, b, b.

Disease-resistance studies. Within the framework of two international projects (Bioexploit-EU FP6 and NAP-BIO-NEWSEED) molecular marker-assisted selection is being used to incorporate known resistance genes (*Lr9*, *Lr10*, *Lr21*, *Lr24*, *Lr25*, *Lr29*, *Lr37*, and *Lr37*) into the Martonvásár wheats Mv Emma, Mv Madrigál, Mv Magvas, and Mv Pálma with good adaptability to Hungarian conditions. The presence of the resistance genes is detected using public PCR-based (STS and SCAR) markers in various backcross generations. In field populations sown for phenotypic testing, selection is made for progeny resembling the recurrent cultivar but possessing leaf rust resistance. Work also has begun on the pyramiding of leaf rust-resistance genes. Various gene combinations are stabilized in progeny plants using the doubled haploid technique.

Research on Fusarium head blight is focussed on identifying genetic factors determining the resistance of the B9086-95 line derived from a population of the old Hungarian cultivar Bánkúti 1201. In earlier field trials, this line was found to have exceptionally good FHB resistance. Two-year data on the type-II resistance of 250 SSD lines originating from a cross between B9086-95 and the cultivar Mv Magvas gave values between 5.0 and 72.3% for the spike infection, thus providing adequate variation for the identification of QTL regions responsible for FHB resistance.

The degree of infection exhibited by genotypes carrying known leaf and stem rust resistance genes was tested in artificially inoculated nurseries. Genes *Lr9*, *Lr19*, *Lr24*, *Lr25*, *Lr28*, *Lr29*, *Lr35*, *Lr37*, and *Lr47* continue to provide effective protection against leaf rust in Martonvásár in 2007, wheras cultivars with gene *Sr36* were still resistant to stem rust. The resistant reaction type and a severity of below 20% were observed for genes *Sr7a*, *Sr9d*, *Sr11*, *Sr27*, *Sr30*, and *SrDr* and for genotypes carrying the gene combination *Sr5+6+8+17*.

Powdery mildew isolates collected in the Martonvásár area were used to determine the race composition of the pathogen population, the degree of virulence, and the efficiency of known resistance genes. The races dominant in 2007 (and their frequency) were as follows: 51 (41.7%), 76 (27.2%), and 77 (12.6%). The number of virulence genes in the pathogen population was calculated as 6.12, which was higher than in any previous year. Almost complete protection against the tested wheat powdery mildew isolates was provided by the resistance gene *Pm4a+* (Khapli).

Plant samples exhibiting symptoms of virus infection were collected from experiments on winter wheat, winter barley, durum wheat, winter oats, and triticale in order to identify the virus species and their incidence. Wheat dwarf virus (WDV) was detected on 100% of the infected durum wheat plants and on 92% of the winter wheat samples. Compared with the previous year, a significant increase in the extent of WDV infection on winter barley was observed (2006, 4%; 2007, 60%). This pathogen was identified on 40% of the triticale samples. None of the oat samples collected in 2007 (25 winter and 25 spring genotypes) were infected with WDV, but the level of BYDV infection was higher than the long-term mean.

Abiotic stress resistance studies. The effect of heat stress on the quantity and quality of cereal grain yields was studied in phytotron chambers. Considerable differences were recorded in the quality parameters of the grain yield from stress-treated wheat plants. Heat stress caused a significant increase in the protein content of the grain. This relative rise in the protein content could be explained by the decline in the 1,000-kernel weight, grain weight, and grain size when high temperature occurred during the grain-filling phase, and by a drastic reduction in the grain number and grain yield per plant when heat stress affected young plants, because high temperature during shooting leads to a substantial drop in the number of spikelets. Despite the increase in the protein content of the grain, the quality of the grain was generally poor, due to the decrease in the insoluble polymer protein fraction and in the glutenin/gliadin quantity. Changes indicative of quality deterioration were chiefly observed at the highest temperature (41°C).

The effect of weather components on the biomass and grain production of cereals and on the quality of the grain yield is investigated in long-term experiments. The results achieved in 2007 indicated that drought stress generally reduced the disease resistance of cereals, whereas a combination of water deficiency and pathogens led to a drastic drop in the grain yield. Although the protein content was higher after drought and severe infection, due to the smaller yield, the gluten content was lower.

In a series of model experiments in the phytotron, correlations between drought stress and increased atmospheric CO_2 concentration were examined on various cereal species and cultivars. Drought stress in the early stages of ripening inhibited biomass accumulation, leading to forced ripening, an increase in the number of sterile kernels and a reduction in the grain mass, resulting in an average 40% reduction in the grain yield per plant. The smaller kernels had a relatively high protein content at the cost of the starch fraction. An increase in the atmospheric CO_2 concentration improved the drought tolerance of cereals; the biomass and grain number per plant exhibited values similar to the control values (normal CO_2 level and water supplies) in drought-stressed plants grown at twice the normal atmospheric CO_2 concentration. The protein content of the kernels increased to a moderate extent due to the opposing effects of high CO_2 level and drought stress.

Studies were made on the effect of the weather conditions and plant pathogens in the 2006–07 growing season on the functioning of the antioxidant enzyme system in cereals. Four of the five enzymes tested gave similar patterns over time for each cultivar, with only slight deviations, whereas a more intense genotype effect was observed at the various sampling dates for the ascorbate peroxidase enzyme, and a general tendency was less noticeable. The results achieved so far suggest that the functioning of this enzyme may be correlated with resistance to powdery mildew.

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Genetic and physiological studies

G. Galiba, G. Kocsy, T. Janda, E. Páldi, G. Szalai, and A. Vágújfalvi.

Identification of candidate genes for frost tolerance. Cbf genes recently have been shown to code for transcription factors and are the most likely candidate genes for frost tolerance in wheat. Frost tolerance tests on a newly developed, einkorn mapping population proved the involvement of three Cbf genes, *Cbf12*, *Cbf14*, and *Cbf15*, in the genetic control of frost tolerance. The Cbf genes regulate the expression of several cold-inducible target genes. Besides Cbfs, other cold-responsive genes selected by cDNA-macroarray were investigated to discover whether there were cold-specific.

Physiological changes during low temperature hardening. The research is investigating the regulatory processes involved in the development of stress tolerance in cereals, with special regard to antioxidant systems that regulate the quantity of reactive oxygen species. Light plays a role in the achievement of maximum frost resistance in wheat. In this connection, changes occurring in various antioxidants, in the salicylic acid metabolism, and in membrane lipids during low temperature hardening were investigated under varying light conditions. We found that when studying the role of salicylic acid-dependent signal transduction pathways, it is important to consider not only salicylic acid itself, but also changes in its precursors.

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