Centre for Agricultural Research
Martonvásár
The network of research institutes maintained by the Hungarian Academy of Sciences achieves national and international success and makes a valuable contribution to Hungarian and universal science through a combination of excellently qualified researchers, authentic science and social commitment. As part of the only network in Hungary devoted purely to scientific research, the Martonvásár-based institute aims principally to play an active role in serving the public good and laying a foundation for the future by achieving valuable results of an international standard, based on Hungarian research traditions.
The Centre for Agricultural Research of the Hungarian Academy of Sciences, the largest agricultural research complex in Hungary, carries out basic and applied research and development in the field of agricultural sciences, participates in the dissemination of professional and scientific knowledge, and works in cooperation with organisations involved in agriculture, animal health, the food industry, rural development, environment protection and sustainable development, at both national and international levels.

The Centre cooperates with other research institutes in Hungary, and maintains contacts both with scientific institutions in other countries and with international scientific societies. It promotes the integration of Hungarian research results obtained in agriculture, soil and environmental science and veterinary science into international scientific life.

In cooperation with various institutions of higher education, it is actively involved in teaching, participating in joint research, education and further training tasks.
The Centre for Agricultural Research of the Hungarian Academy of Sciences

Has its headquarters at H-2462 Martonvásár, Brunszvik u. 2.

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Institutes making up the Centre for Agricultural Research

Agricultural Institute
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Plant Protection Institute
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Institute for Veterinary Medical Research
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Tíbor Jermy
Tamás Kőmíves
Béla Nagy
Miklós Tóth
György Várallyay
Agricultural Institute
Main activities of the institute:

- research on plant adaptation and stress resistance using the techniques applied in cell biology, histology, plant physiology, plant development and reproduction biology, molecular biology, functional genetics, genomics, proteomics, metabolomics, bioinformatics and systems biology;
- establishment and maintenance of a plant gene bank, phenotyping and genotyping of gene bank accessions, improvement of genetic variability, development of new genetic sources through pre-breeding, further development of breeding methods;
- selection of plant genotypes with excellent quality traits promoting healthy human nutrition and animal feeding, and improving food safety;
- breeding of new plant varieties, inbred lines and hybrids with good adaptability to the agro-ecological and climatic conditions in Hungary using conventional and molecular breeding methods and by exploiting the gene pools of local varieties, old Hungarian varieties, exotic sources, and both cultivated and wild related species;
- research on various aspects of sustainable agriculture in crop production experiments and the use of long-term experiments to study the effects of climate change, correlations between crop production factors and the sustainability of agro-ecological systems.

Scientific departments working in the Agricultural Institute:

**Plant Cell Biology Department**
Head: Beáta Barnabás

**Department of Plant Molecular Biology**
Head: Gábor Galiba

**Department of Applied Genomics**
Head: Angéla Juhász

**Department of Plant Physiology**
Head: Tibor Janda

**Department of Plant Genetic Resources and Organic Breeding**
Head: Márta Molnár-Láng

**Cereal Breeding Department**
Head: László Láng

**Cereal Resistance Breeding Department**
Head: Ottó Veisz

**Maize Breeding Department**
Head: Csaba L. Marton

**Crop Production Department**
Head: Nándor Fodor

**Phytotron Department**
Head: Noémi Harnos

Institute Director:
**Zoltán Bedő**
Member of the MTA
The development of the grain in cultivated cereal species starts with double fertilisation. The quantity and quality of the yield depend on a great extent on the success of this process, which is influenced by numerous environmental factors. Plant reproduction biology is one of the foundation pillars of plant breeding. The main profile of the department is the investigation of reproductive processes in cereal species at the cellular and molecular level, and the biotechnology of sexual plant reproduction. Up-to-date in vitro micromanipulation techniques and genomic methods facilitate detailed investigations on the various phases in plant embryo development, thus allowing solutions to be found for problems of basic importance for general developmental biology. High efficiency haploid induction methods are used to examine the factors involved in the initiation of in vitro embryogenesis in microspores, with special regard to the symmetry of the first microspore mitosis and the accompanying changes in cell structure. The effects of extreme environmental stresses associated with global climate change
on the vegetative processes, sexual reproduction and yield production of wheat and maize are investigated. In a recently started project, connections between environmental stress signal transduction and developmental regulation are studied.

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Publications:


The research team deals with the molecular, physiological and cellular background of abiotic stress adaptation in cereals. Based on the results of classical genetic experiments of the Institute, utilizing up-to-date molecular biological methods, detailed function and interactions of regulator genes (COR, CBF and VRN systems) involved in the cold acclimation and flowering processes are investigated. Effects of different alleles of genes with great influence on stress adaptation are studied by association mapping of variety sortiments and populations of wild species. Functions of candidate genes are investigated by genetic transformation and analysis of mutant lines. Beside cereal species, the model plant Arabidopsis is used for the experiments. Detailed investigations are performed on the effects of spectral differences and changes in the redox state of the plants on the gene regulator systems.
Components of those signal transduction pathways which might play role in changing the expression patterns of candidate genes are identified. Beside investigating the molecular background of stress adaptation, association mapping experiments are also performed in which genetic factors with great influence on micronutrient content and nitrogen use efficiency of winter wheat and barley are studied.

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**Publications:**

- **Soltész, A., Smedley, M., Vashegyi, I., Galiba, G., Harwood, W., Vágújfalvi, A.** (2013) Transgenic barley lines prove the involvement of TaCBF14 and TaCBF15 genes in the cold acclimation process and in frost tolerance. Journal of Experimental Botany, 64 (7): 1849-1862; IF=5.364


Seed protein research

Gluten proteins play key roles in defining end-use quality and also health related consequences. Food containing gluten proteins from wheat, rye or barley can cause allergy or celiac disease for a significant number of people. The knowledge of the composition and factors affecting expression levels of these proteins at genotype level is crucial in the quality research, in the determination of environment on protein composition and also in the allergy research. The combined use of tools of bioinformatics, genomics, epigenetics and proteomics results a better understanding of the factors determining sustainable quality and also the level of allergen components present in the food produced from different cereals.

Bioinformatics and computational structural biology support for genomic and proteomic research

Wide range of bioinformatics and molecular modelling tools are available to our department in order to analyse genomic and proteomic research findings in the light of structural biological aspects. These methods provide the possibility to unravel the molecular background of the investigated biological phenomenon, like the molecular modelling of virus and plant protein interactions, to study of cereal epitopes bound to the human HLA antigen presenting proteins. These methods can also be used to compare the binding affinities of the smoke-derived compounds in the newly discovered strigolactone receptor.
Molecular genetic regulation of germination

There are many active components in smoke which have positive or negative effects on the germination and seedling vigour of many plant species, including agricultural crops. By using the high tech of molecular biology the potential target genes and their promoters are studied to determine the role of these compounds in seed germination with the intention of using these components in the future agricultural practice.

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Due to the extreme continental climate, there are hardly any years when Hungary does not face severe economic losses related to environmental factors. In order to develop such crops capable of tolerating environmental changes with as little damage as possible, knowledge of plant defence mechanisms and regulatory processes is essential. The main aims of the Department of Plant Physiology to study the effect of abiotic stress factors (low or high temperature, drought, toxic metals, UV-B, etc.) and the defence mechanisms developed to counteract them with special regard to the antioxidant systems that neutralise the reactive oxygen species formed in the course of stress processes.

Work has long been in progress on the effect of low temperature and of the photoinhibition experienced under stress condition, particularly at the level of photosynthetic processes and of various biochemical or biophysical stress markers. Investigations are also in progress on the role of light in the development of stress tolerance of plants.
In recent years abundant evidence has been amassed on the role of salicylic acid in stress effects. The exact action mechanism of salicylic acid and its derivatives is not known yet. On the grounds of the above, the research is aimed primarily at studying the uptake and metabolism of exogenous salicylic acid and related compounds and the effects of various stressors on the endogenous salicylic acid-related signal transduction processes.

It is expected that the results will enable to pinpoint processes that could be manipulated either by conventional plant breeding or using biotechnology to achieve more efficient improvements in plant stress tolerance.

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Publications:

The main tasks of the Department of Plant Genetic Resources and Organic Breeding are the exploitation of genetic resources of wild species and related cultivated species for wheat improvement (pre-breeding), the maintenance of Martóvásár Cereal Gene Bank and organic breeding. In the course of pre-breeding wheat-alien introgression lines are developed from the backcrossed intergeneric and interspecific hybrids. Triticum, Aegilops and Agropyron species, as well as rye and barley are crossed with wheat. It is planned to transfer genes responsible for biotic and abiotic resistance and favourable quality parameters from these species to wheat. Genome composition of the hybrids and their derivatives are determined by molecular genetic and cytogenetic methods. Identification of the alien chromosomes is carried out using fluorescence in situ hybridisation and is confirmed with molecular markers. In an international cooperation the department participates in flow cytometric sorting and sequencing of chromosomes of Aegilops species which facilitates the development of Aegilops-specific molecular markers.
The Martonvásár Cereal Gene Bank stores wheat related species and genetic materials. Cytogenetic materials are especially important as many of them can be found only here. The task of the Organic Breeding Group is the development of new organic breeding methods and production of alternative wheat and maize species. Breeding of species suitable for organic farming, first of all those that can be grown in marginal areas has been started.

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Publications:


The aim of breeding research on cereals is to describe and preserve valuable genotypes, to develop new basic breeding stock (pre-breeding), to elaborate new methods for improving selection efficiency, and to breed new varieties especially genotypes adapted to the continental climate of the Carpathian Basin. Although the research is concentrated mainly on winter wheat, experiments are also underway on spring wheat, durum wheat, winter and spring barley, triticale, rye, oats and spelt.

**Wheat breeding**
To date, 92 winter wheat varieties have been bred in Martonvásár, 36 of them over the last 10 years. Thanks to their traditionally good stress tolerance and quality, they are competitive not only in Hungary and neighbouring countries, but in all wheat-growing regions where the plants are exposed to cold winters and dry summers. In recent years, wheat varieties with premium quality have gained popularity since these are able to meet local and export market quality demands. For more than two decades, Martonvásár wheat varieties have topped the list of wheat seed sales in Hungary.

**Molecular breeding**
In addition to conventional breeding methods, the application of molecular biological tools also contributes to the birth of new varieties. Among the possibilities offered by biotechnology, tissue culture has been successfully utilised since the 1980s. Advances in genetic knowledge and methodology have opened up the way for the direct analysis of DNA allowing selection for several monogenic traits by using molecular (DNA) markers.
Research on quality
Breeding in the Martonvásár research institute is traditionally aimed at developing hard-grained wheat with excellent bread-making quality. Every year the quality of several thousand of wheat lines is tested in the technology laboratory. In addition to continual improvements in the quality and quality stability of bread wheat, investigations are now underway on endosperm structure and starch properties, wholemeal flour, and the fibre content of the grain.

Research on genetic resources
A collection of cereals, primarily winter wheat, is maintained under refrigeration for medium-term storage. In addition to the lines developed in the Martonvásár breeding programme, the over 10 000 accessions also include many genotypes from many countries.

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The main profile of the department is the investigation of the physiological effects induced by biotic and abiotic stress factors, studying the genetic background and the development of genotypes resistant to these factors. The main aim of research on biotic stress resistance is to improve the resistance of the varieties bred in Martonvásár by means of building in resistance genes via molecular marker assisted selection and to identify DNA-based markers linked to resistance against Fusarium head blight. Research on abiotic stress resistance includes the investigation of the ecological, genetic and physiological background of winter hardiness, frost resistance, heat and drought tolerance. Mapping populations are created for the identification of genes responsible for resistance to heat stress. Investigations are carried out on the interactions between abiotic stress factors and disease infections, and on cross-tolerance. The possible effects of global climate change are studied under field conditions, in the glasshouse and in controlled model experiments in the Phytotron. Research is underway to reveal the exact water use of plants so that the negative effects of precipitation extremes on crop production could be reduced. The changes in the development of barley and wheat in response
to the environment are investigated by means of combining molecular genetic approach and systematic studies on phenotypic traits. Wheat genotypes reacting to weather extremes with the lowest grain yield loss and quality deterioration are selected.

The department is responsible for the breeding and variety maintenance of high-yielding, good quality varieties of winter durum wheat with winter hardiness similar to that of winter barley and spring and winter oats having excellent grain quality.

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Publications:


The most important task of the department is to produce competitive maize hybrids with agronomic value based on the current knowledge of breeding, plant genetics and biotechnology in order to meet the requirements of the producers. Our objective is to collect genetic resources, preserve them in gene banks and evaluate in field and laboratory tests. DUS tests of inbred lines and hybrids are also performed based on the methodology of UPOV directives including the characterization and identification of genotypes with morphologic and genetic markers. The cold and drought tolerance and yield stability of maize is tested in abiotic and biotic stress-resistance trials. The researches aimed to improve resistance against pests and diseases are well emphasized. Ripening dynamics is studied to define the maturity period of hybrids and increase the rate of grain filling and water loss of kernel. For a successful breeding programme, it is essential to discover and use unique genetic resources in the selection of new inbred lines. Monoploid and in vitro dihaploid methods are used to reduce the time of inbred line selection process.
Seed production technologies are elaborated for the newly bred grain, silage and industrial-use hybrids using cytoplasmic male sterile parental lines and including seed vigour tests. The chemical composition and quality of silage maize hybrids is also studied as well as their availability for bioenergy production.

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Publications:

The main research profile of the department consists of basic research carried out in the form of long-term experiments set up by Béla Győrfy 40–50 years ago which are thus the oldest long-term experiments in Hungary. They can be considered as living field laboratories representing a vital part of the national heritage. The sustainability of crop production technologies can only be satisfactorily investigated in long-term experiments.

Wide-ranging studies are performed in bi- and multi-factorial experiments on the agronomic responses (fertiliser utilisation, plant density and sowing date responses, herbicide tolerance) of newly bred maize hybrids and wheat varieties in order to determine or predict optimum treatment ranges and expected yields.

The effects of various agronomic and ecological factors on the yield formation process are measured not only in terms of the end-product (grain yield, biomass), but also by means
of growth analysis and eco-physiological measurements (photosynthetic efficiency, light utilisation, nutrient utilisation).

In addition to field experiments, models now play an increasing role in analysing the effect of crop production factors since they make it possible to investigate relationships between the environment and the yield, and to predict these relationships under diverse ecological conditions. The combination of experimentation, monitoring and models represent an effective approach to understand the interactions between plants, the soil, the weather and technological factors thus promoting the sustainability of production systems.

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Publications:


In the 50 plant growth chambers of the Phytotron in Martonvásár, air temperature, humidity, CO₂ concentration, light intensity and length as well as moisture-content of the soil can be controlled irrespectively of the external weather conditions. Applying Phytotron chambers, the effects of climatic factors that are difficult to understand in nature or can be defined only via long-term experiments can be separated into their components.

Controlled environment means a methodological link in investigating the relationship between plant and environment and unfold part-laws and their rebuilding process. In the past 40 years more than 4000 experiments were carried out in the
Phytotron in Martonvásár and several worldclass scientific results developed. Cereals, maize, tobacco, sunflower were bred, fruit trees, paprika, tomato were examined and plant protection researches were carried out. In the last few years, researches in connection with climate change came into prominence along with molecular plant genetics and physiology, molecular breeding, plant gene banking, agroecological researches, molecular and cell biological investigations of plant sexed processes. Phytotron Department also deals with investigating the effects of climatic factors on plant production and the determining physiological processes with simulation modelling helped by the meteorological station, the member of the national meteorological observing network of the Hungarian Meteorological Service.

<table>
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<th>Phytotron unit</th>
<th>Designation</th>
<th>Quantity</th>
<th>Type</th>
<th>Quantity</th>
<th>Photosynthetic Photon Flux Density (PPFD*)</th>
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</tr>
</tbody>
</table>

*Photosynthetic Photon Flux Density
Plant Protection Institute
Main activities of the institute:

- biology and control of plant pathogens and weeds using conventional, biotechnological and ecological methods;
- development of methods for environmental analysis and monitoring;
- physiological, biochemical and molecular background of plant resistance against viral, fungal and bacterial pathogens; ecological studies on biodiversity and sustainable development in agricultural areas; chemical ecology, population ecology, and the taxonomy of arthropod pests and beneficial organisms;
- development of behaviour-regulating, info-chemical communication systems to regulate arthropod pest populations in agricultural and horticultural fields as well as in urban areas;
- computer-aided (in silico) investigation of structure–activity relationships in order to search for possible lead-compounds to be used as active agents in selective, environment-friendly pesticides; synthesis of pesticide active ingredients and the elaboration of new synthetic pathways.

Scientific departments working in the Plant Protection Institute:

**Department of Zoology**  
Head: Gábor Szőcs

**Department of Biotechnology**  
Head: Lóránt Király

**Department of Applied Chemical Ecology**  
Head: Miklós Tóth

**Department of Pathophysiology**  
Head: József Fodor

**Department of Plant Pathology**  
Head: Levente Kiss

Lendület Evolutionary Ecology Research Group
Leader: Attila Hettyey
The main task of the department is to carry out research for the development of new plant protection methods against pest insects, competitive and safe food-production, sustainable development of agricultural areas and also for solving plant protection problems in urban areas. The main research activities include development of integrated pest management methods, eco-faunistic studies in landscape, road and urban ecology and revealing info-chemicals controlling insects behaviour. Special attention is paid to the spread of alien, invasive and/or quarantine arthropod pests, the role of natural enemies of these pests, the study of disease vectors, taxonomy of selected groups of arthropods using traditional and molecular methods, identification of pheromones and kairomones mediating mating as well as host finding of pests, followed by deeper insight in their mode of action. The study of hormonal (neuropeptide) regulation of biosynthesis of sex pheromones is a new approach to suppress reproduction of pests.

The department is equipped with a special set of instruments including a gas chromatograph with electroantennographic detector (GC-EAD).
and insect flight tunnels for pheromone studies. Electropenetrograph (EPG) is used for measuring feeding of sucking pests, while the vibratory communication of insects can be characterized by a laser vibrometer. The Observer system helps ethological studies in the lab while field surveys are evaluated by geo-informatic systems.

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Publications:


The main task of the department is the application of biotechnological methods in basic and applied pest management research. Research activities are focused on the following three issues: biotechnology-driven control of plant diseases caused by phytoplasmas and bacteria, role of reactive oxygen species and programmed cell death in plant disease resistance, and phytoremediation studies.

The first research field refers to studies on cross-protection effects of pre-infection of host plants with an antagonist strain of 'Candidatus Phytoplasma mali' to induce immunity against closely related, virulent phytoplasmas. Another area is the control of Erwinia amylovora, the causal agent of fire blight of rosaceous plants, using bacteriophage treatments.

As a part of the study of reactive oxygen species and programmed cell death in plant disease resistance, the early accumulation of superoxide
is used as a biochemical marker for non-host resistance and also for other effective plant resistance forms. In addition, an unexpected pleiotropic effect of the tobacco resistance gene \( N \) that controls Tobacco mosaic virus (TMV) infection was recently discovered: the gene enhanced the susceptibility and programmed cell death during infection by Tobacco necrosis virus (TNV).

Phytoremediation research activities include studies on rehabilitation of polluted soils with plants and also on biochemical and molecular mechanisms of plant stress resistance to soil pollutants.

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Publications:

The main activities of the department have been focused on entomological problems in plant protection studied from a chemical ecological point of view. These include basic research studies on insect pests, development of potential solutions of problems raised by these insects and technology transfer activities. The most important activity fields are behavioural studies in connection with chemical and visual communication of insects, isolation and extraction of semiochemicals, elucidation of their chemical structures, evaluation of their applicability based on laboratory experiments and field studies, development of new insect trapping devices and their evaluation in the everyday plant protection practice. A technology transfer product of the department is the CSALOMON® pheromone trap family. The department manages the year-by-year production of trapping devices, continuous introduction of new tools and their quality control which are presented to the growers through the extension service of the institute.
Researchers with scientific degrees:

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Publications:


Research activities are focused on physiological, biochemical and molecular aspects of microbial plant diseases in order to understand the mechanisms of plant disease resistance and susceptibility. One of the crucial topics is the induction of plant resistance against bacterial, fungal and viral pathogens. Disease resistance can be induced in plants by various pre-treatments that do not include direct antimicrobial effects but enhance plant natural resistance against pathogens. Induced resistance was found to be associated with induction of defence-related hormones, changes in cellular redox balance and levels of reactive oxygen species and antioxidants or induction of defence-related enzymes. These studies provide a better understanding of plant defence mechanisms that may lead to the development of new, disease-resistant crop cultivars.

Plants also possess an array of preformed antimicrobial compounds that act directly against pathogens. Numerous antibacterial compounds were isolated from medicinal herbs such as chamomile and identified by chromatography, bioautography and mass spectrometry methods. Biological and molecular characterization of
important plant pathogens, such as *Xanthomonas campestris* pv. vesicatoria, Plum pox virus and new, resistance-breaking strains of Tomato spotted wilt virus are also in focus.

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Publications:


Department of Plant Pathology

Head of Department:

Levente Kiss
DSc

The main task of the department is to conduct research on the identification, biology, ecology and control of fungi and fungal-like organisms that cause crop diseases. In addition, diseases of ornamentals and other plants grown in urban areas as well as problems in forest pathology and plant diseases in natural reserves are also investigated. The development of plant protection technologies based on the use of fungicides and other methods and the application of microbes that may control plant pathogens and weeds as biocontrol agents are in focus as well. Special attention is paid to the etiology and the epidemiology of apple scab, monilia and Phytophthora diseases, fusarioses, especially in relation to mycotoxin production, and diseases caused by powdery mildew and rust fungi. Molecular analyses are used to investigate the precise identification, phylogeny and intraspecific and interspecific variability of Fusarium, powdery mildew, Monilinia, Pyrenophora, Phytophthora and rust species as well as fungicide resistance in some plant pathogenic fungi.
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Publications:


The research group focuses on phenotypic plasticity which is the ability of genotypes to change their phenotype according to altered environmental conditions. In plants it has been known for decades that chemical defences are adjusted to environmental changes in a sophisticated and effective way. However, similar studies on plastic responses in chemical defenses of animals have remained extremely scarce despite of their potential importance for fitness, interspecific interactions, population demography and speciation. Our research group studies whether toxin production of vertebrates – larvae of anuran amphibians – is adjusted to the presence and abundance of predators, competitors or pathogens. While we are
focusing on plastic responses in the production of biogenic and bioactive cocktails of toxins, we will not miss assessing the potential of the detected toxin components for agricultural and medical applications. Apart from our interest in phenotypic plasticity, our research is also concerned with causes and consequences of inter- and intraspecific sexual coercion, the evolutionary background of animal personality, the analysis of animal social networks and the effects of multiple stress factors during early life-stages of anurans. While our group is mainly doing basic research, our studies are highly relevant for conservation biology and have the potential to contribute to important developments in applied sciences.

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Publications:

- Tóth, Z. & Grigio, M. (2011): Leaders are more attractive: birds with bigger yellow breast patches are followed by more group-mates in foraging groups. Public Library of Science One. 6: e26605. Impact factor: 4.09
Institute for Soil Science and Agricultural Chemistry
Main activities of the institute:

- studies on the effects of land-use changes, various land-use systems and climate change on processes involved in the soil, water, material and energy cycles and on the quality of surface waters, including modelling at the field and watershed levels using various spatial and time scales;
- research on the role of interactions between microorganisms, higher plants and the soil in soil processes, plant nutrition and soil remediation, and the characterisation of the ecological status of the environment;
- mathematical modelling of the water and nutrient cycles and the biological processes taking place in the soil–plant–atmosphere system;
- use of digital soil mapping and spatial modelling tools to study soil processes and soil functions over time and space in order to characterise and prevent soil degradation processes, or to moderate their damaging effects.

Scientific departments working in the Institute for Soil Science and Agricultural Chemistry:

Department of Agricultural Chemistry and Plant Nutrition  
Head: Márk Rékási

Department of Soil Biology and Biochemistry  
Head: Nikolett Uzinger

Department of Soil Science  
Head: Kálmán Rajkai
In the field of agricultural chemistry and plant nutrition, the main research task of the department is the analysis of the principles and methods of fertilization advisory service, partly through the use of different models. Additionally, on-going researches reveal the impact of nutrition on cultivated crops (plant development, yield, quality characteristics, disease resistance, fodder value; the diversity of grasslands) and the relationships between soil test data and nutrient element effects. The calculation of nutrient balances on field, farm, regional and national scale is also among the activities of the department.

In the field of agro-ecology research is carried out on the relationships between the characteristics of agro-ecosystems and soil properties determining soil fertility; the effect of weeds on the moisture and substance regime of soils; the influence of nutrient supply on weediness, the species composition of weed flora, the competition, water and nutrient withdrawal of weeds.

In the field of agro-environmental science trials are conducted to determine the agricultural use of sewage sludge and other wastes as well as the “toxic” and “tolerable” limit values for the concentrations of microelement pollutants – with special regard to the contamination of the groundwater and food chain –, to study their mobility in the soil–plant system, and the influencing soil and biological factors...
and to reveal the remediation possibilities of contaminated soils.

From the point of view of professional management, the research stations and long-term field experiments of the institute that are situated in the Mezőföld (Nagyhörcsök), the Danube–Tisza Interfluve (Ôrbottyán) and the Nyírség (Nyírlugos) regions are supervised by the department.

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Publications:


The primary research activities of the department are based on data management and services in the field of environmental informatics and the typically spatial analysis of the data related to environmental resources.

The manifold demands on soil related information are sufficed by the integration of self-developed spatial soil information systems, recent soil assessment based on up-to-date survey technology and digital soil mapping methods.

Spatial assessment and mapping of natural resources, processes and ecosystem services are carried out by spatial modelling and the elaboration of map based environmental databases.

The management and co-ordination of pedological, agrochemical and soil biological data and information collection concerning the environmental state of soils, and their degradation processes are carried out in close co-operation with competent professional organizations. The complex environmental effects of pressures with agricultural origin on soils are investigated with the aid of indication procedures.

Special emphasis is laid on the characterisation of the ecological state of soils by bio-indication methods in laboratory as well as by an automated field monitoring system based on a recently self-developed sensor.
The results of the environmental analysis are published in the frame of internet-based map services thus (i) supporting both national and international duties on the supply of soil and environment related data, (ii) helping the preparation of decision making in the field of agro-environment and rural development, and (iii) aiding soil and environmental awareness.

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Publications:


Scientific research carried out in the department focuses on the quantitative and qualitative assessment of the biological characteristics of the soil–plant–microorganism system by tracking spatial and temporal changes in both natural and agro-ecosystems.

Monitoring methods have been developed recently for the evaluation of soil quality characterised by the biological and degradation state of the soil. Owing to the increased emission of greenhouse gases research is conducted to reveal the details of microbiological processes responsible for soil carbon and nitrogen cycle dynamics and possibilities of their biological regulation.

For better understanding of interactions between plants and microorganisms the mutually beneficial forms of coexistence between soil microorganisms of the root environment (bacteria and fungi enhancing plant growth) and higher plants are studied. The role of arbuscular mycorrhiza fungi in microelement uptake, phosphorus supply and stress reactions of plants is investigated.

Functions of soil enzymes participating in the mineralization of nitrogen and phosphorous compounds are examined in the aspect of nutrient regimes of ecosystems.
For the remediation of contaminated soils and the reduction of their environmental risks biological methods (bioremediation) combined (also) with environmentally sound chemical immobilization are developed. This is achieved by using plants adapted to pollution as well as by promoting and applying different phytoremediation techniques primarily on heavy metal contaminated soils.

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Publications:


- Füzy, A., Tóth, T., Biró, B. Soil-plant factors, others than the type of salt-specific anions are affecting the mycorrhiza colonisation of some halophytes. Community Ecology 2008;9:125-130.


The scientific research task of the department is studying soil physical, chemical and structural aspects of soil water management, the carbon and mineral element cycles and their changes due to environmental stresses.

As one of the main soil physical factors influencing soil water management is the hydraulic conductivity of soils. A well-defined measuring method was worked out and its practical applicability and representativity has been demonstrated.

An electrical bioindication measuring method was applied for detecting the environmental stresses (e.g. pesticide or drought) on plants in the soil.

Studies were launched on the alteration of salt content and ground water flow in soils of flat areas due to (af)forestation.

A modelling tool – based on the created soil database lying on field and lab data – is under development for the risk estimation of salinization on forested sites.

Models are also applied for predicting the effects of climate and land use changes, extreme hydrological situations and different soil cultivation systems on soil water and carbon flow processes for introducing alternative adaptation strategies.
The role of soil in different meteorological situations is studied using weather forecast models. The modelled soil moisture content, convective precipitation and planetary boundary layer height data are to be compared with their measured values as the next program step.

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Publications:

- Tóth, E., Koós, S., Farkas, Cs. Soil carbon dioxide efflux determined from large undisturbed soil cores collected in different soil management systems. Biologia 2009;64(3):643-647.
- Virágh, K., Tóth, T., Somodi, I. Effect of slight vegetation degradation on soil properties in Brachypodium pinnatum grasslands. PLANT AND SOIL 2011;345:(1-2) 303-313
Institute for Veterinary Medical Research
Main activities of the institute:

- investigations on infectious diseases occurring in domesticated and wild animals and on the pathogens causing them (viruses, bacteria and parasites);
- research in the fields of environment protection, molecular biology, biotechnology, immunology and pathology aimed at developing diagnostic and vaccination techniques to improve the control of animal diseases, to provide practical assistance to veterinary surgeons and to increase food safety;
- the identification of the pathogens responsible for major diseases that can be transmitted from animals to humans (zoonoses) and of their animal reservoir species in order to diminish or prevent the risk of infection;
- monitoring the emergence or re-emergence of vector-borne pathogens (possibly related to climate change) and the identification, isolation and characterisation of new pathogens;
- promoting the practical application of the results obtained in veterinary science, and participation in national efforts to overcome infectious diseases.

Scientific groups working in the Institute for Veterinary Medical Research:

**Molecular Virology Research Group**
Head: Mária Benkő

**Comparative Virology Research Group**
Head: Balázs Harrach

**Functional Virology Research Group**
Head: Zoltán Zádorí

**Lendület Pathogen Discovery Research Group**
Head: Krisztián Bányai

**Enteric Bacteriology and Foodborne Zoonoses Research Group**
Head: István Tóth

**Respiratory Bacteriology Research Group**
Head: Tibor Magyar

**Lendület Zoonotic Bacteriology and Mycoplasmology Research Group**
Head: Miklós Gyuranecz

**Fish Parasitology Research Group**
Head: Edit Eszterbauer

**Fish Pathology and Parasitology Research Group**
Head: Csaba Székely

Institute Director:

Tibor Magyar
CSc
Recently, our group works on the molecular genetic characterization of different DNA viruses of lower vertebrates. We completed the genome sequencing of the single fish adenovirus, known to date, and found numerous new putative genes with yet unknown function. Upon our official proposal, a new adenovirus genus (Ichtadenovirus) was established. A new member of another genus (Siadenovirus) – proposed also by our group earlier – was also subjected to whole genome sequencing and analysis. This virus has been found in dead specimens of raptorial birds. The first full genomes of adenoviruses from turkey and goose were also sequenced and published. The herpesviruses occurring in fish are now classified in a new family, Alloherpesviridae. We have determined and studied several
alloherpesviral sequences and — based on their phylogenetic analyses — we made proposals for further subdivision of the family. The sample collection, established for adeno- and herpesviral screening of fishes, amphibians and reptiles, is now used to find novel representatives of other DNA viruses (such as circov- and parvoviruses) by PCRs published by others or designed by us. During the past years, three PhD and several graduate diploma theses were prepared on these topics. Thanks to our international collaborations, foreign experts often spend shorter or longer visits in our laboratory. I am the National Representative for Hungary in the International Committee on Taxonomy of Viruses. I was reelected as chair of the Adenoviridae Study Group when the mandate of my colleague expired.

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**Publications:**

We study the adenoviruses of veterinary importance. We aim at the assessment of the diversity and exploration of the evolution of these viruses. For the comparative analyses of adenoviruses of the domesticated and wild animals and the man, molecular techniques and bioinformatic methods are applied. Our main goal is to unveil the cause and understand the reason of the seemingly elevated pathogenicity of certain animal adenoviruses. We hope to understand the evolutionary history as well as predict the eventual occurrence of host switches and other changes in the future. We try to find and characterize on the molecular level (preferably by whole genome sequencing) novel adenoviruses in taxonomically highly divergent hosts. We expect to discover extreme number of new adenoviruses in the representatives of the two mammalian orders (rodents and bats) that are richest in species. We study the virus-host coevolution...
and try to clarify the cause of eventual rapid changes in the genome organization such as gene deletion, capture or duplication. We also aim to understand the function of novel genes found in the genome of animal adenoviruses especially in comparison with human adenoviruses. My website with the collection of every adenovirus sequence determined to date is daily visited by researchers from all over the world. Based on our knowledge concerning the adenoviral genome organization and experience in bioinformatics, we participate in the analyses and annotation of adenoviral genome sequences obtained by foreign laboratories using next-generation sequencing approach. In a consortium with several Western European laboratories – under the framework of an EU financed project starting in 2013 – we study the possible use of different animal adenoviruses as gene expression system in human medicine.

Publications:

- Doszpoly, A., Benkő, M., Bouo, G., LaPatra, S.E., Harrach, B. (2011) Comparative analysis of a conserved gene block from the genome of the members of the genus le탈urivirus. Intervirology 54, 282-289
In order to help to develop more efficient strategies and tools against economically important viral pathogens our group investigates a number of novel and less studied aspects of the molecular regulation of the viral life cycle. Currently we concentrate our efforts on the members of the parvoviridae family and the nidovirales order.

Parvovirus Research

1. The role of alternative ORFs in the GPV MDPV infection
A large genus-specific ORF (LGORF) was found to overlap the VP ORF in all members of the Dependovirus genus. We want to understand its function in GPV and MDPV by creating mutant viruses and studying their phenotypes in tissue culture and in the host.

2. The effect of methylation PPV replication
CpG methylation is involved in gene regulation and silencing in viruses and their hosts and also, in pathogen recognition as well as activation of the innate immune systems in vertebrates. The PPV genome contains significantly less CpG dinucleotides (around ¼) than expected
from its nucleotide composition. We study the evolutionary origin of this pattern and its effect for the viral life cycle.

**Nidovirus research**

Several economically important viruses are classified in the Nidovirales order (e.g. PRRSV, EAV in the arteriviridae family and FIPV, TGEV, IBV in the coronaviridae family). Although bacterial infectious clones are available for a number of nidoviruses their large sizes hinder the genetic manipulation of the nidoviral genomes by traditional cloning methods such as the use of bacterial cloning plasmids, restriction endonucleases. In order to overcome the difficulties posed by the large genome size we are developing a novel reverse genetic system which can be used not only for nidoviruses but to any system where the manipulation of large size transcripts is necessary.

**Publications:**

Our research group was established in 2011 by qualified young researchers with expertise in different areas of microbiology. The research group focuses on several, partly overlapping research topics. These include new pathogen discovery with the primary objective to describe the diversity of pathogenic viruses, bacteria and protozoa by determining their whole genomes. Such whole genome characterization studies of various viruses and microbes may help us better understand their epidemiological features and their evolutionary mechanisms as well. Therefore, those studies where we aim at describing the molecular epidemiology of selected pathogens are also based on whole genome sequence data. We perform experiments to explore the association of newly recognized viruses and microbes with different disorders. Co-infections with multiple pathogens could make it difficult to determine their role in the induction and progression of the diseases they are responsible for; thus, comparison of the microbiome in healthy and diseased individuals is obligatory. However, detecting all microorganisms simultaneously or those being fastidious is often complicated or practically impossible by using classical microbiological methods. Metagenomic studies...
with high-throughput next generation sequencing give us the opportunity to solve this problem and could help gather new information about the composition of viral and microbial populations.
**Escherichia coli research:** Screening for verotoxin-producing *E. coli* (VTEC) and *E. coli* O157. Investigation and molecular analysis of *E. coli*’s other virulence and fitness factors. Pathogenetic, microbial and phylogenetic characterization of *E. coli* strains.

**Multidrug resistant (MDR) enteric and extraintestinal pathogenic and environmental bacteria** (*Salmonella enterica*, *E. coli* and *Pseudomonas aeruginosa*) are analysed for their zoonotic potential through characterization of their virulence and antimicrobial resistance genes. Studies are directed on the links between resistance and virulence and on pathogenetic significance of mobile genetic elements and on flexibility of bacterial genome and resistome.

Gene expression studies are performed using *in vitro*, *ex vivo* and *in vivo* systems in order to explore host/pathogen interactions regarding native and adaptive immunity. Results confirmed in exact animal experiments will identify targets to design novel vaccines, novel diagnostics and therapeutic applications.

A special attention is given to the commensal *E. coli* and to other MDR bacteria that may constitute a reservoir of virulence and resistance genes for potential transmission to pathogens in the normal gut flora.

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**Leader of the research group:**

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**Bacteriophage research:** Clarification of *E. coli* prophages. Isolation and characterization of lytic phages from *E. coli*, other coliform bacteria. Studying the evolutionary and diagnostic (phage typing) significance and therapeutic potential (phage therapy) of phages.

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**Publications:**


Bacterial respiratory diseases cause significant economic losses worldwide in livestock farming. They are a serious threat for companion animals; moreover, some of these pathogens are able to produce diseases in humans, too. The expansive spread of antimicrobial resistance is especially alarming presenting a constant challenge to both public and animal healthcare.

Our research group examines several pathogenic bacterium species. Research on Bordetella bronchiseptica and Pasteurella multocida have a long tradition in our institute as these bacterial species are ubiquitous in nature and play a role in the development of several important diseases. Also, the interaction between these two agents is a special feature of the pathogenesis of atrophic rhinitis of swine giving a good example of polymicrobial diseases. Our research focuses on the determination of virulence factors and host adaption of the bacteria using traditional and molecular genetic methods (sequence- and phylogenetic analysis). To better understand the development of respiratory diseases, modern medical imaging technology (computed tomography, magnetic resonance imaging) is used in follow-up model experiments.
Recently, the examination of bacterial respiratory pathogens of poultry has been initiated. We are studying the prevalence and the antimicrobial susceptibility of three bacterial pathogen species in Hungary (Bordetella avium, Ornithobacterium rhinotracheale and Riemerella anatipestifer) along with some biological properties of these organisms that are possibly related to virulence. Little is known about the occurrence and genetic properties of the Hungarian isolates of these species. Thus, our work provides useful information for basic research and, at the same time, it helps to improve prevention and therapy of the diseases caused by these microorganisms.

A significant part of our work comes from participation in vaccine development experiments testing various vaccine candidates in different experimental animal models and in field trials in order to find modern and effective preventive methods against infectious animal diseases.

**Researcher with scientific degree:**

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**Publications:**

- **Khayer, B., Rónai, Zs., Wehmann, E., Magyar, T.:** Detection of urease-negative Bordetella bronchiseptica from the field. *ACTA VETERINARIA HUNGARICA* 39:(3) pp. 289-293. (2011)
- **Magyar, T., Donkó, T., Kovács, F.:** Atrophic rhinitis vaccine composition triggers different serological profiles that do not correlate with protection. *ACTA VETERINARIA HUNGARICA* 56:(1) pp. 27-40. (2008)
A broader understanding of health and disease demands a unity of approach achievable only through a consilience of human, domestic animal and wildlife health. Any disease or infection that is naturally transmissible from vertebrate animals to humans and vice-versa is classified as a zoonosis. Our research projects focus on the following zoonotic bacterial agents: Francisella tularensis, the causative agent of the highly contagious zoonotic disease, tularemia – primarily a disease of the orders Lagomorpha and Rodentia; Brucella species, the causative agent of brucellosis – it manifests in abortion in females and in epididymitis, orchitis and inflammation of accessory genital glands in males of different domestic and wild animal species; Coxiella burnetii, the causative agent of Q fever – occurs worldwide and had been associated mostly with late-term abortion and reproductive disorders.
in wild and domestic ruminants; *Chlamydiales* species – causing ornithosis in avian species and abortion in mammals and *Borrelia* species, the causative agent of Lyme borreliosis – the most prevalent vector-borne human disease in the temperate zone of the Northern Hemisphere.

Our other research field is mycoplasmosis. *Mycoplasmas* are the smallest self-replicating organisms known. They have a worldwide distribution as free-living saprophytes or as facultative-pathogen parasites of humans, animals and plants. Our research involves the examination of different *Mycoplasma* species infecting domestic and wild animals.

**Publications:**

The members of the research group study the parasitic infections of freshwater and occasionally marine fish species. With the analysis of the biochemical and genetic background of the host-parasite interaction they ground the development of preventive measures against parasitic diseases. They examine the development and the host range of various fish parasites and the susceptibility of different fish species to parasites. They collaborate in the study of other fish pathogens.

Main research topics:

1. In cooperation with local and foreign fish farms the study of the correlation between the inbreeding level of brown and rainbow trout populations and the susceptibility of farmed fish to parasitic diseases.

2. Comparative study of the development of Myxobolus cerebralis causing whirling disease in salmonids and the common but non-pathogenic M. pseudodispar in relation to the immune response of susceptible and non-susceptible fish species.
3. Detailed genetic and experimental study of Sphaerospora dykovae causing swim bladder inflammation in common carp and other non-pathogenic myxozoan parasite species in order to clarify the aetiology of the disease.

4. Experimental study of the virulence and drug-sensibility of the protozoan parasite Ichthyophthirius multifiliis, possessing the greatest economic significance by causing white spot disease with the aim of developing an anti/protozoal treatment method suitable for fish farms producing for human consumption.

Publications:

The main task of the Fish Pathology and Parasitology Research Group is the general parasitological monitoring of fish species cultured in farm ponds or living in natural waters with special respect to Lake Balaton and its water tributaries. The most important research results have been obtained by studying the damages caused to fish by myxosporeans, coccidia, monogeneans, cestodes and nematodes. The researchers of the group have studied the development of myxosporeans, the primitive metazoans and, in addition to describing several new species in Hungary and abroad they have studied their development, host, organ and tissue specificity and pathomechanism in fish and in oligochaete alternative hosts. Remarkable results have been obtained in studying the occurrence, host specificity, phylogeny and adaptation to hosts of fish coccidia (Goussia and Eimeria spp). Of the helminth infections of fish, the researchers investigated the occurrence, development and pathological effect of monogeneans, cestodes and nematodes. They have described some new species and presented new data on the pathogenesis of diseases caused by them. A recent field of their research is the study of the developmental cycle and zoonotic potential of fish trematodes and their larval stages. Epizootiological, pathological and histopathological studies have been published in connection with the massive eel mortality that took place in the eel population of Lake Balaton due to Anguillicoloides crassus infection. Diagnostic investigations as well as X-ray and computed tomography studies have
been performed in the framework of an EU project. Studying connections between adverse environmental factors and parasitic fish diseases and the effect of climate changes on fish health is a new direction of research. Due to the increasingly strict regulations of the EU effective medication methods previously used for treating fish diseases can no longer be applied. Therefore, we intend to develop alternative solutions in the future. In addition to parasitological research co-operative studies on viral fish diseases have been initiated and the research of bacterial fish diseases has also been started within the research group. Recently, the collection and identification of *Aeromonas* spp. strains obtained from healthy and diseased farmed and wild fishes have begun in order to examine the virulence factors and the clonality of these strains.

**Researchers with scientific degrees:**

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**Publications:**

The Centre for Agricultural Research publishes the following scientific and informative journals related to its research profile.

### Scientific journals

**Acta Veterinaria Hungarica**  
Editor-in-Chief: Balázs Harrach  
E-mail: harrach.balazs@agrar.mta.hu

**Agrokémia és Talajtan**  
(Agrochemistry and Soil Science)  
Editor-in-Chief: György Várallyay  
E-mail: varallyay.gyorgy@agrar.mta.hu

### Extension service publications:

**Martonvásár**  
(reports from the Centre for Agricultural Research of the Hungarian Academy of Sciences)  
Editor-in-Chief: Ottó Veisz  
E-mail: veisz.otto@agrar.mta.hu

The Centre for Agricultural Research of the Hungarian Academy of Sciences takes great pains to promote the social and economic utilisation of the results of scientific research. Research results that are of practical use are patented, and the spin-off companies detailed below are the commercial representatives of the products.

**Martonvásári Elitmag**  
Vetőmagszaporító, Termeltető és Forgalmaztató  
Korlátolt Felelősségű Társaság  
(Elitmag Seed Company Ltd.)  
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Fax: (+36-22) 461-000  
E-mail: vetomag@elitmag.hu  
Website: www.elitmag.hu  
Managing Director: Katalin Cseh  
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E-mail: kati.cseh@elitmag.hu

**Martonvásári Bázismag**  
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Korlátolt Felelősségű Társaság  
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E-mail: bazismag@bazismag.hu  
Website: www.bazismag.hu  
Managing Director: Dr Dénes Oross  
Phone: (+36-22) 461-371  
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**Martonvásári Prebázis**  
Termelő és Kutatás-Fejlesztési Korlátolt Felelősségű Társaság  
(Prebázis Production, Research and Development Company Ltd.)  
2462 Martonvásár, Brunszvik u. 2.  
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Website: www.prebazis.hu  
Managing Director: László Győrfy  
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The Beethoven concerts held in the park since 1958, generally on three occasions each summer, are now a national event. The home of these concerts is an open-air theatre on an island in the lake, with seating for over 2000. Talented musicians from Hungary and abroad are accompanied at these memorable concerts by the National Philharmonic Orchestra.

**Traditions and their preservation**

**The Park** is open from 8 am to 6 pm in summer and from 8 am to 4 pm in winter.

**Beethoven Memorial Museum:**
Opening hours:
- Tues.–Fri.: 10–12 am, 2–4 pm
- Sat. and Sun.: 10 am–4 pm (1 Nov.–31 Mar.)
  10 am–6 pm (1 Apr.–31 Oct.)

**Nursery School Museum:**
Opening hours:
- **16 Oct.–15 Mar.:**
  - Tues. and Fri.: 10 am–2 pm;
  - Sun.: 11 am–3 pm
- **16 Mar.–15 Oct.:**
  - Tues.–Fri.: 10 am–2 pm;
  - Sat. and Sun.: 11 am–6 pm
A Magyar Tudományos Akadémia Agrártudományi Kutatóközpontja (MTA ATK) a legnagyobb magyar agrártudományi kutatóintézet, alapkutatásokat, alkalmazott kutatásokat és fejlesztési tevékenységet végez az agrártudományok területén, részt vállal a szakmai és tudományos ismeretek terjesztésében és együttműködik az agrárgazdaság, az élelmiszeripar, a vidékfejlesztés, a környezetvédelem fenntartható fejlődésében részt vállaló szervezetekkel mind Magyarországon, mind külföldön.

Együttműködik hazai kutatóintézetekkel, kapcsolatokat tart fenn és létesít más országok tudományos intézményeivel, nemzetközi tudományos társaságokkal. Elősegíti a magyar agrártudományi, föld- és környezettudományi és állatorvostudományi kutatások jelenlétét a nemzetközi tudományos életben.

A felsőoktatási intézményekkel együttműködve részt vesz az oktatómunkában, közös kutatási, képzési és továbbképzési feladatokat lát el.