

# **The Status of Agricultural Biotechnology and Biosafety in Ukraine**

## TABLE OF CONTENTS

TABLE OF CONTENTS .....	1
LIST OF ACRONYMS .....	2
ACKNOWLEDGEMENTS .....	4
SUMMARY .....	5
1. Profile of national agriculture .....	6
2. National agricultural policy .....	6
3. Status of agricultural research .....	8
4. National biotechnology policy .....	16
5. Status of biotechnology research .....	16
6. Applications of biotechnology .....	16
7. Regulatory frameworks .....	17
8. State of information and communication needs .....	24
9. Areas requiring support .....	24
10. Participation in networks and international cooperation .....	24
11. Recommendations .....	26
12. References .....	26
Annex 1. Data for FAO-BioDeC - Plants .....	29
Annex 2. Data for FAO-BioDeC - Animals .....	38

## LIST OF ACRONYMS

AI	Artificial Insemination
AMV	Alfalfa Mosaic Virus
APHD	Agricultural Policy for Human Development Project
Bt GM	genetically modified with gene from <i>Bacillus thuringiensis</i>
BLAD	Bovine Leukocyte Adhesion Deficiency
BLV	Bovine Leucosis Virus
BtMV	Beet Mosaic Potyvirus
CAE	Collectivised Agricultural Enterprise
CIDA	Canadian International Development Agency
CNS	kappa-casein locus
cpAMV	coat protein of Alfalfa Mosaic Virus
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo
dsRNA	double-stranded Ribonucleic Acid
DUAP	German-Ukrainian Agriculture and Investment Development Project
ELISA	Enzyme-Linked Immunosorbent Assay
ENGL	European Network of GMO Laboratories
ET	Embryo Transfer
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FAOBioDeC	FAO- database of biotechnologies in developing countries
FISH	Fluorescence <i>In Situ</i> Hybridization
FSU	Former Soviet Union
GDP	Gross Domestic Product
GEF	Global Environment Facility
GM	Genetically Modified
GMO	Genetically Modified Organism
GUS	$\beta$ -glucuronidase (GUS) protein
IAEA	International Atomic Energy Agency
ICSU	International Council for Science
IPFSAPH	International Portal on Food Safety and Animal and Plant Health
IPR	Intellectual Property Rights
ISSR	Inter Simple Sequence Repeats
ISTA	International Seed Testing Association
IVF	<i>In Vitro</i> Fertilization
LSU	Louisiana State University
MAS	Marker Assisted Selection
NACEE	Network of Aquaculture Centers in Central-Eastern Europe
NASU	National Academy of Sciences of Ukraine
NAUU	National Agricultural University of Ukraine
NCC	National Coordination Committee
NGO	Non-Governmental Organization
NSB	National Structure of Biosafety
OACC	Official Association of Analytic Chemistry
PCR	Polymerase Chain Reaction
PSTVd	Potato Spindle Tuber Viroid
PVP	Plant Variety Protection

PVX	Potato Virus X
QTL	Quantitative Trait Loci
R&D	Research and Development
RAPD	Random Amplified Polymorphic DNA
REU	FAO Regional Office for Europe
RNAi	Ribonucleic Acid Interference
RT-PCR	Reverse Transcription Polymerase Chain Reaction
SDR	Research, Extension and Training Division
SIDA	Swedish International Development Cooperation Agency
ST	Somatotropin Locus
STMS	Sequence Tagged Microsatellite Site
UAAS	The Ukrainian Academy of Agrarian Sciences
UNDP	United Nations Development Program
UNEP	United Nations Program for Environmental Preservation
UNESCO	United Nations Educational, Scientific and Cultural Organization
UPOV	International Union for Protection of New Varieties of Plants
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
WHO	World Health Organization

## ACKNOWLEDGEMENTS

This report<sup>1</sup> was commissioned by FAO's Research and Technology Development Service (SDRR) and the Regional Office for Europe (REU). It was prepared on the basis of the mission report<sup>2</sup> of the consultant Ewa Zimnoch-Guzowska, Head of Mlochow Research Center, Plant Breeding and Acclimatization Institute, Mlochow, Poland. Her contribution is gratefully acknowledged. Contact persons from government, science, education and other organizations in Ukraine provided information on agriculture, biotechnology and biosafety compiled in this report. Alla Kravchenko, on behalf of the National Agricultural University of Ukraine, Olena Redkina, of the Ministry of Agricultural Policy, and staff of the UNDP office in Kiev, facilitated the mission by providing administrative support. FAO staff involved in the coordination of the assessment mission and in the review and editing of the final report was Karin Nichterlein, Research and Technology Officer, REU, and Riccardo Del Castello, Communication Officer, Research, Extension and Training Division (SDR).

---

<sup>1</sup> Comments on the document are welcomed and should be addressed to the Research and Technology Officer, Regional Office for Europe, FAO, Viale delle Terme di Caracalla, 00100 Rome, Italy; email: [REUS-Research@fao.org](mailto:REUS-Research@fao.org)

<sup>2</sup> Mission from 9 to 20 May 2005; some contacts given in the report might have changed, if known they have been updated.

## SUMMARY

Ukraine was a major food producer as part of the former Soviet Union and it retains tremendous agricultural potential. Ukrainian agriculture was founded on collectivised agricultural enterprises that have, since independence in 1991, largely been replaced by more modern ventures that increasingly take sustainability into account. Improved agro-processing facilities and agricultural production methods have made the agricultural sector a principal contributor to GDP despite outstanding difficulties in securing agricultural credit. Several internationally supported agricultural sector reform projects have operated in Ukraine during the past decade. Agricultural and food science research is conducted through a large, nationwide network of research centers of the Ukrainian Academy of Agrarian Sciences and by about twenty agricultural universities. Agricultural biotechnology is a national priority and following ratification of a national agricultural biotechnology programme, implemented in 2001-2005, a national commission was established to address issues of biotechnology and biosafety policy. To date, traditional agricultural research and development receives greater emphasis than biotechnology, but *in vitro* plant multiplication, molecular aids to plant breeding, livestock reproductive technologies, artificial inoculants and fermentation technologies are researched and the results applied commercially. Legislation concerning genetic modification has yet to be implemented, although consumer rights, food safety, and intellectual property rights are legislated for. Support to agriculture in general, and biotechnology in particular, is required in capacity building and funding. Teaching and training in modern methods of agricultural production, and creation of a conducive policy environment, will support development in Ukraine. Information generation and communication will have to be improved through improved access to standard and modern information technologies and also through strengthened capacity in English. Moreover, increased involvement in international networks and improved international cooperation in research and development, particularly with countries of the European Union, will help Ukraine to become a more active participant in the international arena.

## **1. Profile of national agriculture**

Ukraine has tremendous agricultural potential. Fifty-seven percent of its 60 million ha of total land area is cultivated, but about 90 percent is cultivable. The abundant black soils (chernozem) are particularly fertile. As part of the former Soviet Union (FSU), Ukraine was a major contributor to food production, accounting for about a quarter of the agricultural output. Russia remains Ukraine's principal trading partner. Ukraine achieved independence in 1991, since when agricultural production has fallen to less than 50 percent of former levels as changes in agricultural policy and land reform have not attracted sufficient investment in the agricultural sector. Recent economic liberalization has encouraged greater investment and production has generally increased since 2000. There was a disastrous harvest in 2003 resulting from adverse weather conditions, when there was an overall 10 percent drop in agricultural production. This was, however, followed by a bumper harvest in 2004. Agricultural output grew by nearly 5 percent between 2004 and 2005, although real GDP fell over the same period.

Agriculture and the food industry represent a key sector of the Ukrainian economy that ranks second to the metals sector in its contribution to manufacturing output. About 15 percent of GDP is produced within the agricultural sector and export of agricultural products, including food and drink, account for more than ten percent of total exports. Employment in agriculture, forestry and fisheries in 2003 was estimated as 23 percent of the total labour force.

The main agricultural crops are grain, sunflower and sugar beet, produced predominantly by large farms, but potatoes, vegetables and fruits are also widely grown, mainly by small-scale farmers. Yields of all crops have generally risen over the past ten years, but remain lower than the European averages as crop management is limited by investment in agrochemicals. Livestock numbers have fallen, with corresponding decreases in milk and meat production.

Ukraine has had to contend with several problems in its transition from a republic of the FSU to an independent country. In 1986 an accident at the Chernobyl nuclear power plant contaminated large areas of agricultural land that have been taken out of production. The accident affected about a quarter of Ukraine's agricultural land. There was also widespread industrial pollution from old-fashioned heavy industry and land degradation due to unsustainable agricultural practices. In addition, land reform began after independence and involved the dismantling of collectivized agricultural enterprises (CAEs). The process of privatization of agricultural land began only in 2002, after the Land Code of Ukraine was passed. Most of the 11 000 CAEs were gone by mid-2001, but banks were disinclined to lend for investment in private agriculture and consequently input purchase was sub-optimal. The situation has now changed and investment is growing, although agricultural land cannot yet be used as collateral to secure loans until a moratorium on land sales is lifted in 2006.

## **2. National agricultural policy**

It became essential to develop a new agricultural policy in Ukraine as part of the major economic reforms that accompanied independence in 1991. As a republic of the FSU, Ukrainian agriculture was founded on CAEs. These have largely been dismantled and replaced with private enterprises, including farms, businesses and newer style joint-ownership

ventures. Associated processing industries have also been reformed. It will soon be feasible to use agricultural land as collateral to secure loans for farm improvement. It is expected that increased access to credit and increased use of modern inputs will enhance productivity. However, there is recognition that natural resources have to be conserved for sustainable production to flourish, and agriculture should not impact negatively on the environment. Agricultural policy therefore emphasises good agricultural management to halt the decline in soil fertility that has come about through using inappropriate agricultural practices associated with state-owned agriculture. Moreover, genetic improvement of crops and livestock is an essential component of the new policy.

Improved access to credit will need to be accompanied by reinforced ties between farmers and commerce, and improved market conditions. Currently Ukraine exports little to Europe, despite sharing borders with the EU, but Russia remains the main trading partner. New labour and wage policies have been instituted following privatisation of agriculture that keep agricultural wages in line with the new economic conditions. This conforms to the national strategy for poverty alleviation.

The 2006 budget allocates at least ten percent of total government spending to supporting agriculture and the social infrastructure of the rural areas. The package includes guaranteed grain purchase price, agricultural insurance subsidy, livestock subsidy, low-interest loans for producing agricultural machinery (which will facilitate purchase), keeping a land-use register and implementation of measures to improve soil fertility. The success of agricultural policy will depend heavily on developing a market infrastructure, creating an entrepreneurial cadre and encouraging a competitive environment.

Several major projects have operated in Ukraine in support of reform of the agricultural sector:

- **The Agricultural Sector Adjustment Loan** (1996-1998, US\$ 300 million) – supported by the World Bank, aims to implement the key economic reforms in the agricultural sector: liberalization of domestic and foreign trade, privatization and the break up of state monopolies, land reform and farm restructuring; funding for strategic imports. The result was to be an improvement in the general performance of the sector.
- **Rural Land Titling and Cadastre Development Project** - in 2003, the World Bank extended a loan of US\$ 195 million to implement this land reform project.
- **Seeds Development Project** (1995-2000, US\$ 63.3 million) - funded by the World Bank. The goal of the project was to improve the management of the maize, sunflower and sugar beet seed.
- **Agricultural Policy for Human Development Project** (APHD) – from UNDP, USAID, the World Bank. The APHD focuses on developing donor supported capacity to evaluate agricultural issues in Ukraine, to formulate policy alternatives and to assist in the coordination of decisions and policy implementation in Ukraine's agro-food sector.
- **Agribusiness Development Program** (2003-2008) - funded by the Canadian International Development Agency (CIDA) and the Swedish International Development Cooperation Agency (SIDA). The goals are directed at: (1) supporting of the reform of Ukraine's primary agriculture and food industry, (2) facilitating the creation of profitable farming, (3) promotion of rural development, (4) provision of partnership opportunities for Ukrainian and Canadian companies.

- **USAID-funded program** (since 1998) - coordinated by the LSU AgCenter's for the improvement of private agriculture in Ukraine through agricultural extension. The program is focused on training university faculty and consultants in extension methodology and providing education for farmers.
- **German-Ukrainian Agriculture and Investment Development Project - DUAP.** Focused on promoting business cooperation between Ukrainian and German agro-industrial enterprises to enhance competitiveness of Ukrainian enterprises in domestic and international markets. Project activities: (1) development of private advisory services, (2) training of agro-managers, (3) development of professional associations in the agricultural sector, (4) promotion of cooperation between agro-enterprises in both countries.

### **3. Status of agricultural research**

Agricultural research is conducted in a large nationwide network of research centers of the Ukrainian Academy of Agrarian Sciences (UAAS) and by about 20 agricultural universities. Many of these institutions are listed in Table 1 with a brief account of their research activities and principal contacts. The UAAS oversees research in all aspects of agricultural and food science, including training, through the work of eight departments:

- Land cultivation
- Plant production
- Animal breeding
- Veterinary medicine
- Food and processing industry
- Mechanisation and electrification
- Agrarian economics and land relations
- Regional extension services

These eight departments comprise 56 research institutes with 154 experimental and seed production farms. The number of UAAS employees totals about 124 000, including over 5 000 researchers. Major areas of research include:

- Agro-landscape management for natural resource conservation
- Biotechnology
- Agronomy and plant breeding
- Animal husbandry and breeding (including humane treatment of livestock)
- Food technology development

**Table 1.** Biotechnology in public and private research institutions in Ukraine

Institution	Contact	Programme details, strengths and weaknesses
National Agricultural University of Ukraine (NAUU)	Prof. Dmytro. O. Melnychuk Rector, NAUU <a href="mailto:rector@nauu.kiev.ua">rector@nauu.kiev.ua</a> tel.: (38-044) 2575175 fax: (38-044) 2577155	NAUU is the largest agricultural university in Ukraine, comprising eight education and research institutes with 20 Faculties. NAUU Kiev center is supplemented by six regional centers (institutes and colleges). Student numbers total ca. 20 000.
Department of Ecobiotechnology, NAUU	Dr. Maxim D. Melnychuk Director, Research and Education Institute of Environmental Protection and Biotechnology, NAUU Chair of the Dept. Ecobiotechnology, NAUU <a href="mailto:Maksym@nauu.kiev.ua">Maksym@nauu.kiev.ua</a> tel./fax: (38-044) 278430 mobile: (38-067) 62338732	Biotechnology is a specialization in the Agronomy and the Plant Protection faculties of the NAUU. The Department of Ecobiotechnology has recently been established. Currently there are about 50 students. Studies on application of <i>in vitro</i> technology to micropropagation of virus free plant material; viral diagnostics with ELISA, PCR and electron microscopy; somatic hybridization; use of molecular markers (RAPD); plant agro-transformation with viral construct to enhance resistance to viruses (cpAMV in pea and bean); detection with RT-PCR dsRNA of BtMV in sugar beet; gene silencing studies on RNAi with PVX, AMV, BtMV in potato, tomato and sugar beet. Well developed <i>in vitro</i> laboratory with cultures of hop, potato, tomato, <i>Petunia</i> , <i>Surfinia</i> , grapevine, tobacco. Wide range of plant species studied <i>in vitro</i> .
Ukrainian Laboratory for Quality and Safety of Agricultural Products, NAUU	Dr. Sergey D. Melnychuk Director, Laboratory of Quality and Safety of Agricultural Products, NAUU <a href="mailto:Quality_lab@nauu.kiev.ua">Quality_lab@nauu.kiev.ua</a> <a href="mailto:smelnich@nauu.kiev.ua">smelnich@nauu.kiev.ua</a> tel./fax: (38-044) 2678954	Founded in 2003, accredited in 2004. Staff of 85, including 8 Ph.D. and 17 Ph.D. students. Laboratory is adapted to test: quality indices of plant and animal products; safety indices (heavy metals, nitrates, radionuclides, aflatoxins, pesticides, metabolites, toxicity determination, GMO presence in plant products, seeds, fruits etc.); quality indices of grain, grain products and flax; quality indices of water, sewage, mineral and organic fertilizers; biochemical blood indices; diagnostics of animal diseases (with PCR and ELISA); pre-registered tests of plant pesticides and agrochemicals. The laboratory can test up to 1 000 food/feed samples p.a. and up to 500 grain samples. New, very well equipped laboratory with an input of international funds (FAO project TCP/UKR/3003). Young staff of the laboratory is partly trained abroad. Spectrum of techniques available at the laboratory covers: light and electron microscopy, liquid and gas chromatography, MAS spectro-chromatography, real time PCR, nucleic acid sequencing, serological testing, including ELISA.
National Academy of Sciences of Ukraine (NASU)	Dr. Sergey Myakushko Head of Dept. of Foreign Relations <a href="mailto:svm@nas.gov.ua">svm@nas.gov.ua</a> tel.: (38-044) 2352239 fax: (38-044) 2396635 mobile: (38-044) 4933338	NASU is the largest state research organization, with 512 academicians and 130 foreign members. Present structure of the NASU includes 3 Sections, 13 Departments, about 170 institutes and other research institutions, and 13 000 researchers. NASU participates in the work of over 20 international organizations incl. UNESCO, WHO, IAEA, ICSU. Significant contribution to the multilateral cooperation of the academies of sciences of the Black-Sea countries. NASU plays a key role for the integration of science and education led by Ukrainian universities. Performs coordinating functions for other five academies of sciences in Ukraine. General biology department covers group of institutes involved in modern biology: genetic engineering, genomics, and molecular basis of pathways for adaptation processes, protection of natural resources and preservation of biodiversity. Department is led by Prof. D.M.

		Grodzinsky.
Institute of Cell Biology and Genetic Engineering, NASU & International Institute of Cell Biology (IICB)	Prof. Yaroslav B. Blume Director, Institute GMO Legislation and Detection of GM <a href="mailto:yablume@cellbio.freenet.viaduk.net">yablume@cellbio.freenet.viaduk.net</a> tel.: (38-044) 2661498 fax: (38-044) 296103	<p>The leading scientific center in plant biotechnology, a pioneer of research in cell and genetic engineering in Ukraine. This center also includes the International Institute of Cell Biology. Staff of 150 including 5 professors, 11 D.Sc. and 52 Ph.D. The institute is a teaching and training unit - 6 to 12 undergraduate students p/a. Three departments and one laboratory: Dept. of Genetic Engineering; Dept. of Genomics and Biotechnology; Dept. of Biophysics and Radiobiology; Laboratory of Cell Biology and Biotechnology of Fungi.</p> <p>Basic molecular studies on plant cell function. Development of new techniques for cell and plant engineering. Development of <i>in vitro</i> techniques for plant biodiversity conservation. Large <i>in vitro</i> germplasm collection of world's flora. Production of biological materials and extracts from plants for pharmaceutical and agrochemical screening for IICB. Studies on the role of the cytoskeleton directed to developing plants resistant to biotic and abiotic stresses. Methods for phytomicrobic soil decontamination from radionuclides. Development and application of somatic hybridization of plant species. Production of cybrids. Development of plant transformation protocols using various methods. Chloroplast genome transformation. Transgenesis of major agricultural crops and production of pharmaceutical proteins and alkaloids.</p> <p>Prof. Ya. Blume engaged in elaboration of legal regulatory documentation for GMO biosafety. The institute is applying to be a reference laboratory for GMO testing of food, plant products and plant material. It is well equipped and has well trained specialists.</p> <p>IICB was created as a "virtual body" providing research on request. The projects and technologies proposed for joint research or commercialization include: technologies for plant microclonal propagation; genetic transformation and creation of transgenic plants; a method for screening soil pollution with herbicides of antimetabolic activity; a technology for phyto - decontamination of ecosystems from radionuclides; and a sorbent of heavy metals and radionuclides.</p> <p>Each year, up to 10 scientists from other institutions visit IICB. The specialists from IICB work all around the world. There are several ongoing international collaborative works with British, US, German and Dutch institutions and companies.</p>
Ukrainian Institute for Plant Variety Examination  Service for Protection of Rights for Plant Varieties	Viktor V. Volkodav Director <a href="mailto:sops@sops.gov.ua">sops@sops.gov.ua</a> tel.: (38-044) 25700	<p>State-owned and funded scientific research institution subordinated to the State Service for Protection of Rights to Plants Varieties. Created in 2002. Headquarters in Kiev and 25 regional centers. Staff of nearly 1 200, including 81 researchers. Aims: scientific support for research in the field of protection of rights to plant varieties and state scientific and technical assessment for determination of suitability of varieties for legal protection and dissemination in Ukraine. Scientific development of issues connected with acquisition, registration and utilization of rights to plant varieties. Scientific support of maintenance of state registries of applications for varieties of plants, rights of owners of plant varieties, varieties eligible for dissemination in Ukraine, and state registration of applications, patents and varieties.</p> <p>The institute maintains a genebank of varieties. Samples are deposited for short-term and long-term storage. Post-registration testing of varieties, evaluation of quality of varieties.</p> <p>The institute closely cooperates with member countries of UPOV.</p> <p>Equipped laboratories for testing physical properties of seeds and quality characters. Small laboratory for GMO detection not fully equipped and lack of specialists to do this work. Temporary collaboration with an institute in Novi</p>

		Sad, Belgrade, for testing plant and seeds samples for GM presence. Strong need for consultations and training in GMO detection and in establishment of an updated system.
Ukrainian Academy of Agrarian Sciences (UAAS)	Dr. Oleg Guzevatiy Head of Agrobiotechnology Section <a href="mailto:guzevatiy@fromru.com">guzevatiy@fromru.com</a> <a href="mailto:uaas_bio@nauu.kiev.ua">uaas_bio@nauu.kiev.ua</a> tel.: (38-044) 2809114 fax: (38-044) 2263284 mobile: (38-067) 9924161	Founded in 1990, as a self-governing scientific organization. The center's role is to guide and coordinate agricultural research in Ukraine. The UAAS monitors trends in research, draws up programs on important problems in agriculture, water management, food and processing industries, and other sectors in agro-industry and supervises the work programs. Also supports the implementation of research and network activities among scientific institutions. Provides training for specialists, and organizes international cooperation. The UAAS networks comprise 56 scientific-research institutes with their units.
Institute for Fisheries, UAAS	Dr. Olehsandr O. Oleksienko Secretary of Science of the Fisheries Institute, UAAS tel.: (38-044) 4237466 (38-044) 4237461	Leading research institution in aquaculture and inland fishing. Staff of 130 employees including 37 Ph.D. Institute is subsidised ca. 75 percent by the UAAS. Remaining income from contracted projects (5 percent) and services (20 percent). Main goals: research and development in aquaculture, rational utilization of aquatic living resources of inland waters, environmental safety and training of qualified professionals. Studies: fish genetics and selection, cryoconservation of sexual products; development and improvement of fish rearing in polyculture; development and improvement of the technologies of artificial propagation of various fish species; stock conservation and rehabilitation of rare and endangered species; fish diseases, their prophylaxis and treatment; research and recommendations on rational utilization of the aquatic living resources of continental inland waters; marketing research. Genetic studies are conducted at DNA level on sturgeon (collaboration with Hungary and Poland) and common carp (immunogenetics). Well developed studies on cryoconservation of fish spermatozoids for artificial fertilization. Studies on artificial fish propagation collaboration with Czech Republic. The laboratories of the institute are renovated and access is restricted. Lack of internationally supported programs. The institute is a member of the Network of Aquaculture Centers in Central-Eastern Europe (NACEE) created in 2004.
The Institute of Animal Breeding and Genetics, UAAS	Dr. Svitlana I. Kovtun Head of the Laboratory of Cell Engineering <a href="mailto:Kovtun_si@gala.net">Kovtun_si@gala.net</a> tel.: (38-044) 9530035 fax: (38-044) 9530540	Founded in 1975 as the main center for selection and genetic studies of agricultural animals. Staff of 200, including 8 professors. The Institute has several departments, including laboratory of cell engineering, cytogenetics, biotechnology. Methods of stock raising based on creating new highly productive milk breeds. Development of meat breeds. Advanced research in reproductive techniques: cryoconservation of bull and pig sperm, cryoconservation of embryos in cows, pigs, <i>in vitro</i> maturation and fertilization in cattle and pigs, sexing of cattle embryos (using PCR), studies on obtaining embryos of cattle and pigs using <i>in vitro</i> fertilization of oocytes, Studies on parthenogenesis activation of cow oocytes. Research in genetic identification of animals: evaluation of karyotypes, identification of chromosomal abnormalities in cattle, pigs, horses, fish; identification of cattle origin based on blood groups and protein polymorphism; national genebank of germplasm of cattle, horse, pig, goat, birds, fish, bees, silkworm (at present in cryoconservation 40 embryos of cattle, sperm of cattle and pigs), MAS - molecular and cytological markers: identification of the chromosome Y of Zebu type, stress gene in cattle (PCR), stress gene in pigs (PCR), kappa-casein in milk (PCR), BLAD, Bovine Leukocyte Adhesion Deficiency (PCR).

<p>Plant Breeding and Genetics Institute, National Center of Seed and Cultivar Investigation, UAAS</p>	<p>Prof. Vyacheslav M. Sokolov, Director General, Head of the Maize Dept. tel.: (38-048) 2395289 fax: (38-048) 2395401</p>	<p>Created in 1912. Staff of 453 (92 researchers: 11 D.Sc. and 54 Ph.D.). The research from genetics to practical breeding of agricultural crops. 10 departments and 7 laboratories. Research aims: development of modern plant breeding methods, research on seed production of agricultural crops and improvement of their quality, improvement of methods in quality breeding of cereals, genetic study of quantitative traits, resistance breeding to biotic and abiotic stresses, breeding new cultivars.</p> <p>Substantial achievements in breeding new varieties and hybrids of cereals and other seed crops - over 270 new cultivars. Production of certified seed is a source of 50 percent of income. The institute and its seven experimental stations have over 30 000 ha. About 12 000 tonnes of elite seed are produced annually. Field experiments are well developed, including plots for testing resistance to various fungal diseases.</p> <p>Genetic studies: enlargement of gene pool by wide crosses and introgression of alien genes into wheat, application of embryo rescue; interspecific hybridization to increase variation for quality traits in wheat; genetic studies of winter wheat growth habit; MAS- microsatellite markers linked to <i>vrn1</i>, <i>ppd 1A</i> - major genes determining the vernalization period. <i>In vitro</i> anther culture and <i>bulbosum</i> method used for double haploids production in cereals. Research on transgenic wheat with enhanced backing quality through gluten production by overexpression of genes involved in its synthesis. International collaboration with UK and USA.</p> <p>Collection of 2000 isolates of pathogenic fungi. Resistance breeding in cereals against yellow rust, stem rust, leaf rust, <i>Fusarium</i>, <i>Septoria</i>. Testing on field plots after artificial inoculation. Collaboration with Canada and CIMMYT. Generally suffers from lack of funds. The huge phytotron for physiological and genetic studies from 1970 is inoperable. Greenhouses need renovation.</p> <p>Six years ago the biotechnology group was separated from the institute, and set up as the South Plant Biotechnology Center of UAAS.</p>
<p>South Plant Biotechnology Center, UAAS and MES</p>	<p>Prof. Yuri Sivolap, Director tel./fax: (38-048) 2395557 <a href="mailto:Yuri@genome.intes.odessa.ua">Yuri@genome.intes.odessa.ua</a></p>	<p>The South Plant Biotechnology Center was created in 1999. Scientific staff of 35 including 1 professor, 2 D.Sc. and 15 Ph.D. Two laboratories: Molecular Genetics, Tissue Culture and Organs <i>in vitro</i>.</p> <p>Studies: molecular markers applied in plant breeding: for prediction of yield heterosis (SSR, ISSR, RAPD); fingerprinting of cultivars of maize, soft wheat, barley, sunflower; microsatellite markers for QTLs for frost resistance of winter wheat; markers for Rf gene restorer for male sterility in sunflower; STMS analysis for identification and catalogue of wheat varieties registered in Ukraine; analysis of barley <math>\beta</math>-amylase gene in Ukrainian barley germplasm. Markers for selection of sunflower resistant to <i>Orobanche cumana</i>.</p> <p>Exploration of <i>in vitro</i> techniques: double haploids by androgenesis and <i>bulbosum</i> method. Introgressive hybridization of <i>T. aestivum</i> and <i>Aegilops tauschii</i> by using <i>in vitro</i> methods; micropropagation of <i>Arnica foliosa</i> L.</p> <p>Molecular characteristics of <i>Fusarium</i> species distributed in the southern region of Ukraine.</p> <p>Cytoembryological study of Graminea in tissue culture experiments. The center is applying for state certification for testing of plant material and plant products for GMO presence.</p> <p>Researchers well educated and able to work with advanced molecular techniques.</p> <p>The center is relatively well equipped (PCR, growth chambers, sequencer), but there is lack of modern equipment and lack of funds for ongoing management of the center (electricity, water, heating). Current lack of ongoing international partnership.</p> <p>The source of additional income for the center is a paid service for human paternity, and human DNA identification for criminal services in Odessa region.</p>

<p>Institute of Agroecology and Biotechnology, UAAS</p>	<p>Dr. Natalja A. Makarenko Deputy Director for Science tel.: (38-044) 2526270</p>	<p>Established in 1992, aims to create the theoretical background for sound development of stable agro-ecosystems, and increased productivity and rational exploitation of natural resources. Staff of 225, including 5 professors, 20 D.Sc, 50 Ph.D. and about 60 Ph.D. students. Well developed training and teaching.</p> <p>Studies: monitoring stability of agro-ecosystems, genetic components of stable agro-ecosystem development, modelling of multilevel agro-ecosystems for farms of various size and property types, forecasting development of agro-ecosystems for optimal use of restorative resources and energy, reproduction of optimal structure of agro-landscapes and biodiversity.</p> <p>Radio-ecological monitoring for Cs+137, service for evaluation of the content of macro- and micro- elements - sources of additional income for the institute.</p> <p>In the Laboratory of Biotechnology of Microorganisms and Viruses research on production of bio-preparations based on bacteria for nitrogen fixation or antagonistic against insects and fungi. The income from sales of bio-preparations covers 30 percent of institute budget.</p> <p>Countrywide monitoring to identify zones recommended for ecological farming.</p> <p>Studies on micro-evolutionary factors affecting the genetic structure of local populations of Colorado potato beetle tested with RAPD markers.</p> <p>In the Radiology and Molecular Genetics Laboratory research on PCR markers in cattle for kappa-casein locus (CNS), somatotropin locus (ST) and BLAD. RAPD markers applied for estimation the phylogenetic relations between domestic and wild mammalian species. The DNA technology has been used for diagnostics of retro-virus infection with provirus BLV.</p> <p>ISSR markers used for genetic monitoring of cattle families for three to four generations living in the condition of low dose ionizing chronic radiation in a 30 km radius from Chernobyl.</p> <p>ISSR markers applied to evaluate range of genetic variation in sheep, pigs, and horses.</p> <p>Research on genetic consequences of transgenesis of the rabbit with <i>lac Z</i> gene in the respect of expression of other structural genes.</p> <p>In Plant Biotechnology Laboratory and Molecular Diagnostics research on eradication of pathogens from germplasm stored <i>in vitro</i>. Developed diagnostics for PSTVd (in potato) with the RT-PCR method.</p> <p>The GMO research is in initial stages - directed at evaluation of variation of GUS expression among transformed potato cultivars. As element of biosafety issues, ongoing experiment on micro-evolutionary changes in Colorado potato beetle population after feeding on Bt-GM potatoes and maize.</p> <p>Studies on risk assessment for cultivation of transgenic crops. Horizontal transfer of the transgene Bt-endotoxin from Bt-GM maize into soil. The laboratory is applying for certification to test for GM in plant seeds, plants materials and plant products.</p> <p>The institute is relatively well equipped, but not sufficiently supplied with materials and spare parts for ongoing research. The sequencer owned by the institute is not in use.</p> <p>Collaboration at the international level is not well developed. Some collaboration with Polish, Russian and Hungarian research centers. The institute edits "Agroecological Journal".</p>
<p>Research Institute of Alcohol and Biotechnology of Food</p>	<p>Dr. Sergiy T. Olynychuk, Director <a href="mailto:info@spirt.kiev.ua">info@spirt.kiev.ua</a></p>	<p>Supervised by the Ministry of Agricultural Policy, the Department of Food Processing Industry. Staff of 156. Each year 10 to 15 student intake. Financially self-dependent: financed from own projects and services. Comprises six departments.</p>

Products	tel.: (38-044) 4420232	<p>Studies related to alcohol production: Resource-saving law - waste technology of ethanol production, technology of joint production of alcohol and bakers yeast, carbon dioxide from molasses, the collection of 300 industrial strains of microorganisms for food biotechnology, technology of biosynthesis of glutamic acid by co-culture of <i>Corynebacterium glutamicum</i> VNDI on molasses wort, technology for production of beta-glucans, nucleic acids, invertases in process of starch biodegradation, technology of grain stillage utilization for dry protein feed, etc.</p> <p>Analytical Center for Product Quality Control is working on upgrading accreditation to European system - about 10 000 tests are made on 1 000 samples of food products yearly (meat, fish, milk products, baked products, fruits, vegetables, tea, coffee, wines and spirits, fats etc.). Willing to test for GM in food products.</p> <p>Very limited international contacts. Collaboration with <i>Bureau veritas</i> in France and participation in TACIS program.</p> <p>Lack of ongoing joint projects with EU members.</p>
The Institute for Potato Growing, UAAS	Dr. Anatoliy A. Bondarchuk, Director tel.: (38-044) 7741560	<p>Founded in 1968. Staff of 200, including 45 researchers: 23 D.Sc. and 3 Ph.D.</p> <p>The main goal is the scientific investigation of potato production problems in Ukraine.</p> <p>Currently operating with US\$ 150-200K budget, but operating cost is US\$ 400-500K. Has bred and released 40 potato varieties.</p> <p>Areas of activity: breeding research, certified seed production and technology of potato production, creation of new potato varieties, production and supply of high quality elite seed material of potato, consultation and marketing services, elaboration and improvement of technologies for: seed reproduction, for storing and processing potato cultivars.</p> <p>Institute has 470 germplasm accessions from 35 wild species, 124 adg. 58 phu accessions and 100 cultivars. Intensive pre-breeding efforts concentrate on disease resistance, agronomy/earliness. Secondary traits include early blight, <i>Fusarium</i> and golden nematode resistance, and high dry matter. About 10 selections are offered to advanced breeders each year for use as parental lines. Research is conducted on True Potato Seed (TPS) cultivars.</p> <p><i>In vitro</i> laboratory is attempting to select somoclonal variants resistant to pathogens and exploration of somaclonal variation to enhance heat and drought tolerance in selected cultivars.</p> <p>Attempting to use defensin constructs (amaranth and radish origin) from Russia to improve late blight resistance, and Bt constructs of Russian origin for enhanced resistance to Colorado potato beetle: conducts phenotypic screens - seeking for collaboration.</p> <p>Virus elimination involves thermotherapy and agglutination tests or ELISA. <i>In vitro</i> rapid multiplication is applied for production of virus free plantlets and minitubers – nuclear materials for elite seeds production.</p> <p>Institute is poorly equipped and needs investment in equipment and reagents.</p> <p>Valuable potato germplasm, both breeding and genebank materials, need investment and special care to be properly stored.</p> <p>Some contacts in China, Belarus and Poland – based on bilateral agreements. Lack of EU projects and connection to ongoing European research.</p>
EFI Monsanto Ukraine, Monsanto Imagine	Helen Fomina, Director General <a href="mailto:Helen.Fomina@monsanto.com">Helen.Fomina@monsanto.com</a>	<p>The Monsanto Company entered Ukraine as chemical company in early 1990.</p> <p>The first trials with GM crops were carried out in Ukraine in 1997-1999. Trials of three New Leaf Potato varieties, resistant to Colorado potato beetle: NL Russet Burbank, NL Superior and NL Atlantic. In 1999 ca. 1200 tonnes was destroyed due to lack of permission for planting the material.</p>

	<p>tel.: (38-044) 4907568  mobile: (38-050) 4699912  fax: (38-044) 4900145</p>	<p>Other trials with GM crops performed in Ukraine according to Monsanto include:</p> <ul style="list-style-type: none"> <li>• State testing of Roundup Ready maize (GA21) in 1998</li> <li>• State testing of Roundup Ready sugar beet in 1998 (in cooperation with Novartis)</li> <li>• Liberty Link Sugar Beet and Liberty Link Rape oil tested by Bayer (formerly Aventis).</li> <li>• Roundup Ready Sugar Beet (in cooperation with Monsanto) tested by Syngenta (formerly Novartis).</li> </ul> <p>At present the company is engaged in selling seeds of conventionally bred maize and sunflower hybrids and chemicals – mainly Roundup, Harnec, Monitor, Dekalb. Lack of legislation for GMO plays a significant role in the biotech scenario in the country (as stated by Monsanto representatives).</p>
--	--	--

#### **4. National biotechnology policy**

Biotechnology features prominently in the development of Ukrainian agriculture. Basic and applied biotechnology research is conducted under the auspices of the NAS and UAAS in addition to the national universities. An agricultural biotechnology programme was formally ratified for implementation in 2001-2005. Furthermore, in June 2004 a Presidential Decree established the Interagency Commission on Biological and Genetic Safety under the authority of the National Security and Defence Council of Ukraine. The commission was charged with analysis of conditions and threats to national security from biotechnology and genetic engineering. The commission was to be fully cognisant of international experience and monitor research and application of biotechnology in all national bodies. Specifically, the commission concerns itself with:

- Defining national interests and priorities regarding development of biotechnology and GE
- Developing appropriate national policy on biosafety and bioterrorist threats
- Modification of the legal statutes governing issues of biotechnology and its safe use
- Establishment of interagency networks and their administration on issues of biotechnology and GE
- Facilitating information flow at government level on issues and implications of biotechnology research and application

#### **5. Status of biotechnology research**

Compared with established agricultural research, relatively little biotechnology research is done in the crop and livestock sectors. Due to human resource constraints, in terms of capacity and funding, little biotechnology teaching is done. Lack of appropriate policy has also limited research and testing of biotechnology products, particularly GM crops. However, a range of biotechnology-related activities are pursued, albeit on a small scale. These include:

- *In vitro* conservation and multiplication of agricultural crops
- Investigation of somaclonal variation with a view to selecting transgressive types
- Androgenic haploid production
- Production of intra and interspecific somatic hybrids
- Transgenesis using various methods
- Establishment of MAS procedures
- Identification and labelling of GM products
- Risk-assessment for GM products

#### **6. Applications of biotechnology**

*In vitro* multiplication of elite, pathogen-free plant material represents the most used plant biotechnology. The market for healthy plant materials is expanding in the public and private sectors, and micropropagation is practised for crops, including hops and potatoes, ornamental

plants, including carnations and petunias, fruits and trees. Molecular aids to plant breeding, such as MAS and transgenesis, are not yet at a developed stage. Commercial GM varieties of potato, maize, sugar beet, and rapeseed with insect or herbicide resistance, developed by multinational companies abroad, were imported and tested in field trials between 1997 and 1998. The trials were discontinued due to the unclear legislation and lack of enforcement procedures and none of the introduced GM varieties was registered for commercialization.

In the livestock sector biotechnology applications are mostly in connection with reproduction, such as artificial insemination (AI), using cryopreserved semen, and molecular markers and diagnostic tools are little used, except that MAS was used to reduce pig stress syndrome, BLAD in cattle and testing for the kappa-casein gene in cow's milk. Embryo transfer (ET) is used in cattle breeding, but high costs restrict its use. IVF, *in vitro* maturation and fertilization, has been little explored. ELISA and PCR-based diagnostics have been used in studies on livestock pathology.

There is a market for biotechnological products, including those based on fermentation and artificial inoculants to promote nitrogen fixation in legumes.

A comprehensive list of biotechnology research areas and applications, for both plants and livestock, is provided in the two FAO-BioDec annexes (Annex 1 and 2).

## **7. Regulatory frameworks**

Ukraine has signed various national and international statutes that concern human and environmental health and protection of biodiversity. The country ratified the Convention on Biological Diversity (CBD) in 1995, acceded to the Cartagena Biosafety Protocol of the CBD in 2002 and became Party to it in 2003. The ratification of the biosafety protocol has not resulted in the development and implementation of a comprehensive biosafety regulatory framework. The possibilities for undertaking research using genetic engineering and deployment of GMOs are not unequivocally specified in national legislation, although the development of biosafety legislation is in process and a draft law "On the state biosafety system for development, testing and usage of genetically modified organisms", is being reviewed by parliament.

As of May 2005, no GMO plants have been grown for sale in the country and there is not a well defined procedure in operation for registering a GM plant variety. Conventionally developed plant varieties must be registered with the State Service for Plant Varieties Rights Protection before their seed can be imported for commercial release. For the import and testing of GM crops a provisional procedure was approved by the Cabinet of Ministers of Ukraine in 1998 in response to requests for GM crop registration. Field studies of insect resistant GM potatoes, produced by a private multinational company, took place in 1997 and 1998. In 1998, more GM crops were tested in field trials, including sugar beet and maize with herbicide resistance, insect resistant maize, and herbicide resistant rapeseed, developed by multinational companies. A moratorium existed at the time on commercial dissemination of GMOs. The trials were halted in the absence of consensus on the impact of the tested GM crops on human health and the environment. None of the tested GM crops were registered.

Existing legislation on quality and safety of food products and food raw materials from 1997 requires that food containing GM components is appropriately labelled. However, the country's capacity for GMO detection and enforcement of the law is weak. The national law On the Fundamentals of National Security of Ukraine, from 2003, lists the uncontrolled import of transgenic plants and their products, and unjustified use of GM organisms and their products as threats to national interests and national security.

Intellectual property of plant varieties, and plant variety protection rights are addressed in national laws on Protection of Rights to Plant Varieties passed in 1993, and 2002 (amendments to 1993 law). Ukraine has been a member of UPOV since 1995.

A list of key contacts involved in biotechnology research and biosafety is given in Table 2.

**Table 2.** List of key contact persons involved in biotechnology research and biosafety in Ukraine

Institution	Address	Name
Ministry of Health of Ukraine	7, M. Grushevsky str., 01021, Kiev	Alla A. Grigorienko Head of Sanitary – Epidemiologic Dept. Chief of Feed Hygiene Dept. <a href="mailto:grig@moz.gov.ua">grig@moz.gov.ua</a> tel.: (38-044) 2530713 Policy contact
		Dr. Svetlana Omelchuk Head of Department of Sanitary and Epidemiological Standardization and Regulation <a href="mailto:omel@moz.gov.ua">omel@moz.gov.ua</a> tel.: (38-044) 2539484 Policy contact
Ministry of Agricultural Policy	24, Khreshchatik str., 01001, Kiev <a href="mailto:minapk@i.com.ua">minapk@i.com.ua</a>	Olena Redkina Deputy Head Division of Investment Policy and Agribusiness Development <a href="mailto:lenakiev@i.com.ua">lenakiev@i.com.ua</a> tel.: (38-044) 2298123 (38-044) 2298394 fax: (38-044) 2284954 Policy contact
		Dmitr M. Mikityuk Head of Dept. of Animal Production Industry Markets with the Main State Breeding Inspection tel.: (38-044) 2784364 Policy contact
		Anatolij M. Litovchenko Deputy Head of the Dept. of Animal Production Industry Markets with the Main State Breeding Inspection tel.: (38-044) 2762414 Policy contact
Ministry of Ecology and Natural Resources	35, Urytskiy str., 03035, Kiev	Sergiy Gubar Deputy Director of the Dept. for Biotic, Land, Water Resources & Econet <a href="mailto:sgubar@menr.gov.ua">sgubar@menr.gov.ua</a> Policy contact
		Olehssandr Bon Dept. for Biotic, Land, Water Resources & Econet Chief of Division of Azror and Black Sea <a href="mailto:bon@menr.gov.ua">bon@menr.gov.ua</a>

		Policy contact
UNEP-GEF Project on development of biosafety national framework for Ukraine	Ministry of Ecology and Natural Resources 35, Urytskyi str., 03035, Kiev tel.: (38-044) 2063127 fax: (38-044) 2063134	Sergey Bomchak National Project Coordinator biosafety@ukr.net
EFI Monsanto Ukraine, Monsanto Imagine	4, Bulvar I. Lapse Silver Center 03680, Kiev fax: (38-044) 4900145	Helen Fomina Director General <a href="mailto:Helen.Fomina@monsanto.com">Helen.Fomina@monsanto.com</a> tel.: (38-044) 4907568 mobile: (38-050) 4699912 fax: (38-044) 4900145
		Dr. Mikhailo M. Kuzyura Marketing Manager <a href="mailto:Mykhailo.M.Kuzyura@monsanto.com">Mykhailo.M.Kuzyura@monsanto.com</a> tel.: (38-044) 4907564 mobile: (38-050) 3301775 fax: (38-044) 4900145
Ukrainian Ecological Association (UEA) "Zelenyi Svit" (Green World)	4, Contraktova Square, 252070, Kiev-70 tel.: (38-044) 4243388 (38-044) 4170283 fax: (38-044) 4174383 <a href="mailto:zelsvit@p5com.com">zelsvit@p5com.com</a>	Adel V. Bosak Director of UEA
		Vasiliy Slesarenko Member of Intl. Academy of Ecology, GMO legislation <a href="mailto:US_p5com.com">US_p5com.com</a>
		Dr. Olha Gorishna Medical sciences, water quality mobile: (38-050) 9775363
National Agricultural University of Ukraine (NAUU)	15, Geroyiv Oborony str., 03041, Kiev tel.: (38-044) 2578242 fax: (38-044) 2577155	Prof. Dmytro.O. Melnychuk Rector of NAUU <a href="mailto:rector@nauu.kiev.ua">rector@nauu.kiev.ua</a> tel.; (38-044) 2575175 fax: (38-044) 2577155
		Dr Alla G. Kravchenko Assistant to the Rector of NAUU <a href="mailto:Alla.Kravchenko@nauu.kiev.ua">Alla.Kravchenko@nauu.kiev.ua</a> tel.: (38-044) 257824
		Dr. Maxim D. Melnychuk Director of the Research and Education Institute of Environmental Protection and Biotechnology, NAUU Chair of the Dept. of Ecobiotechnology, NAUU <a href="mailto:Maksym@nauu.kiev.ua">Maksym@nauu.kiev.ua</a> tel./fax: (38-044) 2678430 mobile: (38-067) 2338732
	Laboratory of Quality and Safety of Agricultural Products, NAUU 16, Polkovnyka Potechina str., Building 12, 03127, Kiev <a href="http://www.qualitylab.com.ua/en/">http://www.qualitylab.com.ua/en/</a>	Dr. Sergey D. Melnychuk Director of the Laboratory of Quality and Safety of Agricultural Products, NAUU <a href="mailto:Quality_lab@nauu.kiev.ua">Quality_lab@nauu.kiev.ua</a> <a href="mailto:smelnich@nauu.kiev.ua">smelnich@nauu.kiev.ua</a> tel./fax: (38-044) 2678954
		Dr. Victoria Lokhanska Deputy Director of the Laboratory of Quality and Safety of Agricultural Products, NAUU <a href="mailto:V.Lokhanska@nauu.kiev.ua">V.Lokhanska@nauu.kiev.ua</a> tel./fax: (38-044) 2678954

		Dr. Vlad Spirydonov Laboratory of Plant Virology and Biotechnology, NAUU
	Dept. of Animal Genetics and Biotechnology, NAUU 15, Geroyiv Oborony str., 03041, Kiev	Dr. Victor I. Sheremeta Head of the Dept. of Animal Genetics and Biotechnology. Director of Educational Scientific Center, NAUU <a href="mailto:Vsheremeta@nauu.kiev.ua">Vsheremeta@nauu.kiev.ua</a> tel.: (38-044) 4123277 fax: (38-044) 2637155
		Dr. Lubov W. Medison Dept. of Animal Genetics and Biotechnology, NAUU tel.: (38-044) 2678770 mobile: (38-067) 2382393
National Academy of Sciences of Ukraine, NASU	4, Volodymyrska str., 01601, Kiev <a href="http://www.nas.gov.ua">www.nas.gov.ua</a> tel.: (38-044) 2352239 fax: (38-044) 2396635	Dr. Sergey Myakushko Head of the Department of Foreign Relations <a href="mailto:svm@nas.gov.ua">svm@nas.gov.ua</a> tel.: (38-044) 4933338
		Prof. D. M. Grodzinsky Member of NASU, Secretary of the Dept. for General Biology
Institute of Cell Biology and Genetic Engineering, NASU & International Institute of Cell Biology	148, Zabolotnoho str, 03143, Kiev <a href="http://www.icbge.org.ua">www.icbge.org.ua</a> <a href="http://cytgen.com/icbge">http://cytgen.com/icbge</a> tel./fax: (38-044) 2667104	Prof. Yaroslav B. Blume Director of the Institute GMO legislation, detection of GM <a href="mailto:yablume@cellbio.freenet.viaduk.net">yablume@cellbio.freenet.viaduk.net</a> tel.: (38-044) 2661498 fax: (38-044) 296103
		Dr. Nikolay V. Kuchuk Deputy Director of the International Institute of Cell Biology Dept. of Genetic Engineering <a href="mailto:kuchuk@iicb.kiev.ua">kuchuk@iicb.kiev.ua</a>
		Dr. Valeria Belokurova Scientific Secretary of the Institute <a href="mailto:lera@iicb.kiev.ua">lera@iicb.kiev.ua</a> Collection of plant germplasm
		Dr. Maria Bannikova Senior researcher in the Genetic Engineering Dept. <a href="mailto:masha@iicb.kiev.ua">masha@iicb.kiev.ua</a> Somatic hybridization
		Dr. Yuri Sheludko Researcher in the Genetic Engineering Dept. <a href="mailto:ysheludko@fromru.com">ysheludko@fromru.com</a> Transgenics for recombinant proteins
Ukrainian Institute for Variety Examination  Service on Rights Protection for Plant Varieties	15, Henerala Radimtseva str., 03041, Kiev <a href="http://www.sops.gov.ua">http://www.sops.gov.ua</a> tel.: (38-044) 2579933 fax: (38-044) 2579934	Viktor V. Volkodav Director of the Center <a href="mailto:sops@sops.gov.ua">sops@sops.gov.ua</a> tel.: (38-044) 2570037
		Svitlana O. Tkachyk Head of the Laboratory for Quality Examination tel.: (38-044) 2579935

		O. V. Zhmurko tel: (38-044) 2678167 English interpreter
Ukrainian Academy of Agrarian Sciences (UAAS)	9, Suvorov str., UAAS, 01010, Kiev-10	Dr. Oleg Guzevatiy Head of the Section of Agrobiotechnology <a href="mailto:guzevatiy@fromru.com">guzevatiy@fromru.com</a> <a href="mailto:uaas_bio@nauu.kiev.ua">uaas_bio@nauu.kiev.ua</a> tel.: (38-044) 2809114 fax: (38-044) 2263284 mobile: (38-067) 9924161 Agricultural research contact
		Dr. Olehsandr I. Kostenko Head of the Dept. of Animal Production and Veterinarian Medicine, UAAS tel.: (38-044) 2805057
Institute of Fisheries, UAAS	135, Obuhivska str., Kiev tel.: (38-044) 4267474	Dr. Olehsandr O. Oleksienko Secretary of Science of the Fishery Institute, UAAS tel.: (38-044) 4237466 (38-044) 4237461
The Institute of Animal Breeding and Genetics, UAAS	1, P.L. Pogrebnjaka str. Vil. Chubynsky, Boryspil District, 08321, Kiev Region tel.: (38-044) 9530032 fax: (38-044) 9530540	Dr. Svitlana I. Kovtun Head of the Laboratory of Cell Engineering <a href="mailto:Kovtun_si@gala.net">Kovtun_si@gala.net</a> tel.: (38-044) 9530035 fax: (38-044) 9530540
		Dr. Petr A. Trockyj Cryoconservation
		Prof. Boris E. Podoba Genetic base for breeding
		Olha D. Birukova <a href="mailto:o_d.birukova@zeos.net">o_d.birukova@zeos.net</a>
		Larisa I. Ostapovic <a href="mailto:ost_lara@mail.univ.kiev.ua">ost_lara@mail.univ.kiev.ua</a> Cell engineering
		Oksana V. Stcherbak <a href="mailto:krasilnikov@tsv.kiev.ua">krasilnikov@tsv.kiev.ua</a> Cell engineering
		Valenitna V. Dziutsiuk <a href="mailto:gvmz@yahoo.com">gvmz@yahoo.com</a> Genetic base for breeding
Plant Breeding and Genetics Institute. National Center of Seed and Cultivar Investigation, UAAS	3, Ovidipolska str., 65036, Odessa tel./fax: (38-048) 2395401	Prof. Vyacheslav M. Sokolov, Director General of the Institute Head of the Maize Dept. tel.: (38-048) 2395289 fax: (38-048) 2395401
		Dr. Nikolaj A. Litvinienko Deputy Director for Science Head of Wheat Breeding Dept. tel./fax: (38-048) 2395401
		Dr. Garri V. Kostandi Senior Researcher International cooperation <a href="mailto:kostandi@tekod.odessa.ua">kostandi@tekod.odessa.ua</a> tel.: (38-048) 2395536 fax: (38-048) 2395289
		Dr. Alexander Rybalka

		Head of Quality Dept. <a href="mailto:alex_ryb@te.net.ua">alex_ryb@te.net.ua</a> tel.: (38-048) 2395234
		Dr. Victor Fayt Head of Genetics Dept. <a href="mailto:fayt@paco.net">fayt@paco.net</a> tel.: (38-048) 2395461
		Dr. Olga Babayants Head of Phytopathology and Entomology Dept. <a href="mailto:fungi@ukr.net">fungi@ukr.net</a> tel.: (38-048) 2395520
South Plant Biotechnology Center, UAAS and MES	3, Ovidipolska str., 65036, Odessa tel./fax: (38-048) 2395557	Prof. Yuri Sivolap Director of the Center <a href="mailto:Yuri@genome.intes.odessa.ua">Yuri@genome.intes.odessa.ua</a>
		Dr. Sabina Chebotar Deputy Director of the Center <a href="mailto:schebotar@yahoo.com">schebotar@yahoo.com</a> Molecular markers
		Dr. Ignatova Svetlana Olexandrivna <a href="mailto:Isa_plant@te.net.ua">Isa_plant@te.net.ua</a> Doubled haploids by androgenesis and <i>bulbosum</i> method
		Dr. Kozhuhova Natalia Eduardovna <a href="mailto:natavolk@rambler.ru">natavolk@rambler.ru</a> DNA-markers for identification of maize lines and hybrids
		Dr. Solodenko Angela Evgenivna Molecular markers for sunflower resistance to pathogens
		Dr. Balvinska Marina Sergiivna <a href="mailto:balvinska@mail.ru">balvinska@mail.ru</a> Molecular markers in barley
		Galaev Oleksiy Volodimirovich <a href="mailto:galaev7@rambler.ru">galaev7@rambler.ru</a> DNA-markers for resistance in cereals
		Dr. Zambriborsch Irina Sergiivna <a href="mailto:i.zambriborsh@paco.net">i.zambriborsh@paco.net</a> Introgression in cereals
		Zelenina Galina Artemivna Micropropagation
		Shestopal Oksana Leonidivna Cytogenetics
		Galaeva Maria Viacheslavivna QTL for frost resistance in cereals
		Efimenko Volodimir Georgievich <a href="mailto:voldemar80@mail.ru">voldemar80@mail.ru</a> Genotyping of maize
		Derevianko Olga Olexandrivna <a href="mailto:derevyanko_o@rambler.ru">derevyanko_o@rambler.ru</a> Molecular markers for <i>Fusarium</i> characterization
		Dr. Maximova Vira Ivanivna Cytoembryology of Graminea
		Stratula Olga Romualdivna Molecular markers for beta amylase in barley
Institute of	12, Metrologichna str., 03143,	Dr. Natalja A. Makarenko

Agroecology and Biotechnology, UAAS	Kiev <a href="mailto:iab@agrobiotech.org">iab@agrobiotech.org</a> tel.: (38-044) 266-2338 fax: (38-044) 5262338	Deputy Director for Science tel.: (38-044) 2526270
		Prof. Valeryi I. Glasko Head of the Dept. of Radioecology <a href="mailto:glasko@biotech.relc.com">glasko@biotech.relc.com</a> Radioecology, DNA techniques in animal science
		Dr. Olena V. Scherstoboleva Head of the Dept. of Monitoring and Biotechnology of Microorganisms and Viruses tel.: (38-044) 5226758 mobile: (38-050) 6071837
		Dr. Grygorij P. Petjuch Head of Plant Biotechnology Lab. <a href="mailto:gpetjuch@ukr.net">gpetjuch@ukr.net</a> <a href="mailto:gpetjuch@yahoo.com">gpetjuch@yahoo.com</a> tel./fax: (38-044) 2526271
Research Institute of Alcohol and Biotechnology of Food Products	3, Babushkin side str., 03190, Kiev tel.: (38-044) 4420232 fax: (38-044) 4490311 (38-044) 4431048	Dr. Sergiy T. Oliynchuk Director of the Institute <a href="mailto:info@spirt.kiev.ua">info@spirt.kiev.ua</a> tel.: (38-044) 4420232
		Dr. Yevgeniy Mikhnenko Deputy Director of the Institute <a href="mailto:info@spirt.kiev.ua">info@spirt.kiev.ua</a> tel.: (38-044) 4420225
		Dr. Evgeniy Pisarev Head of Analytical Dept. Head of the Quality Control Center <a href="mailto:evgeniy@spirt.kiev.ua">evgeniy@spirt.kiev.ua</a> tel/fax: (38-044) 4420414
The Institute for Potato Growing	22, Chkalova str., 07853 vil. Nemishaeve, Borodyanskiy District, Kiev Region <a href="mailto:upri@visti.com">upri@visti.com</a> tel.: (38-044) 7741533 fax: (38-044) 7741542	Dr. Anatolij A. Bondarchuk Director of the Institute tel.: (38-044) 7741560
		Dr. Kutzenko Vasyji Deputy Director for Science
		Dr. A. Podgayevsky Potato prebreeding program, Solanum hybrids, germplasm collection
		Dr. Andrij A. Ospichuk Head of Selection Dept. Cultivar breeding
		Dr. Vasyl Semenovich
		Dr. Olejnik Tatyana <i>In vitro</i> , cell selection, transformation of potato
		Dr. Ryazacev Vasilij Rapid multiplication, mini-tubers, seed production

## **8. State of information and communication needs**

There is a general problem with access to internet and e-mail in Ukraine that impacts negatively on communication of information on biotechnology and biosafety. This includes information generated within the country and that from outside sources. Promoting use of both modern and traditional channels of communicating information will be of immediate benefit. It might also be possible to improve on the prevailing situation through increased support and promotion of current providers of information on biotechnology and biosafety, including FAO-BioDec<sup>3</sup>, the International Portal on Food Safety and Animal and Plant Health (IPFSAPH)<sup>4</sup> and the European Network of GMO Laboratories (ENGL)<sup>5</sup>, until a comprehensive national information system is developed and operational. Information generation and communication would also benefit from strengthening capacity in European languages, particularly English. Currently there are relatively few competent English speakers in the scientific community, although this varies according to institute and age, which makes it difficult to access information from outside the Russian speaking community and disseminate information generated in-country to a wider audience. These problems are reflected in the capacity of national libraries, which in any case have limited resources, and also in the administration that supports scientific research and development.

## **9. Areas requiring support**

Ukraine has undergone major structural changes since independence. Growth of a private agricultural sector has been encouraged and the public sector has been substantially reformed. Reliable and diverse markets for agricultural products and derived products will however have to be expanded and consolidated. The reform process is still as yet incomplete despite major changes having been made. As a consequence of the current state of development, support is needed in the biotechnology and biosafety areas in terms of funds and capacity building. In particular there is need to improve and expand teaching and training in modern methods of agriculture, including biotechnology research and its application. This will require that changes are made to university curricula and better collaborative research is undertaken within the country among existing centers of excellence, but particularly with research and development organisations outside the country. It will also be necessary to improve access to important information sources, including major scientific journals and the internet. Naturally, there will be a need to expedite appropriate policy and design the necessary legislation to cover new areas of research and development. Public awareness of biotechnology will also need to be enhanced through the mass media.

## **10. Participation in networks and international cooperation**

There are relatively few institutions with ongoing international collaborative projects in biotechnology and biosafety. Links that once existed among the republics of the FSU and

---

<sup>3</sup> [http://www.fao.org/biotech/inventory\\_admin/dep/default.asp](http://www.fao.org/biotech/inventory_admin/dep/default.asp)

<sup>4</sup> <http://www.ipfsaph.org>

<sup>5</sup> <http://engl.jrc.it>

included Ukraine broke at independence without new ones forming. Such collaboration as exists is mainly reliant on contacts at the individual level. There is a perceived need to strengthen contacts and collaboration with institutions and individuals in the EU. Table 3 details some of the collaborative ventures that currently exist.

**Table 3.** International collaboration in biotechnology and biosafety

Ukrainian institution	Collaborating institution	Details of collaboration
National Agricultural University of Ukraine (NAUU)	Iowa State University, USA Louisiana State University, USA	Setting educational standards
NAUU	EU and US universities	TEMPUS/TACIS project on food quality
NAUU	Weihenstephan University of Applied Sciences, Germany	Student exchange within a Masters programme in agriculture, part of a project on exporting German study programmes in the interest of supporting international cooperation
NAUU	FAO	Project on food industry development in Ukraine for developing quality management, certification and standardization
NAUU	Government of Japan	Establishment of quality and safety standards for agricultural products and testing for presence of GMOs
International Institute of Cell Biology (IICB)	Organizations in USA, Canada, Europe, Vietnam, China, Cuba, Venezuela, Ecuador, Namibia and Australia	Collaborative research projects
IICB	Cyanamid, Princeton, USA Schering, Berlin, Germany Nunhems Zaden, Haelen, The Netherlands	International joint ventures
Plant Breeding and Genetics Institute, UAAS, Odessa	Rothamsted, UK Western Regional Research Center, USDA, Albany, USA	Studies on transgenic wheat through overexpression of genes for gluten production
Ukrainian Institute for variety Examination	Corresponding institute in Novi Sad, Serbia	Testing for GMOs
Institute of Animal Breeding and Genetics, UAAS	Institute of Zoology, Krakow, Poland Institutes in USA, Canada and UK	Sexing and implanting cattle embryos
Institute of Agroecology and Biotechnology, UAAS	Institute of Animal Genetics of the Polish Academy of Sciences	Studies on rabbits transformed with <i>lac Z</i> gene
Institute of Fisheries, UAAS	Institutes in Poland, Hungary and Czech Republic	Collaborative activities of the Network of Aquaculture Centers in Central-Eastern Europe, NACEE (25 institutions from 13 countries)

Three broad-based international programmes exist that involve Ukraine:

- The Ukraine SPAC project, “Green choice for Ukraine” is supported by NOVIB, The Netherlands. It aims to support development of sustainable, environmentally-friendly agriculture and improved consumer awareness in Ukraine. Environmental education is a main feature of the programme.

- The Black Sea Ecosystem Recovery Project (BSERP) aims at capacity building for managing and protecting the aquatic environment.
- MAMA-86 is a Ukrainian environmental NGO created in 1990 in the wake of the Chernobyl accident.

## **11. Recommendations**

The recommendations are set against a background of major reform in the country that aims at improving the efficiency of the agricultural and food processing sectors through modernisation. Recent changes in the political climate of Ukraine should allow changes to the economy to be made more easily and Ukraine is not affected by internal conflict nor has problems with neighbouring countries that would detract from being able to institute reforms.

- Development and institution of national legislation covering research on and release of GMOs is a priority. This should clearly indicate lines of responsibility and authority within the country. Coordination and implementation of international conventions and protocols should also be well-defined.
- Improvement in education, which has generally suffered from under-funding, is also important. This should cover the entire spectrum, from farmers and consumers to undergraduates, researchers and policy makers. It will need to address agriculture, food processing, biotechnology and many related areas of research and development where capacity is currently underdeveloped.
- Improved communication among institutions and researchers within the country and between Ukrainian and foreign institutions will benefit Ukraine and its research and development programmes. Within the country there is a need to document research programmes and let the scientific community know who is doing what. Greater use of standard communication channels, including meetings, workshops, newsletters etc., is necessary, but more use of modern communication channels, such as the internet, should be made. Currently, less than 5 percent of the population has access to the internet and a low number of fixed telephone lines is dampening growth.
- Applications of biotechnology that are currently being used, such as *in vitro* methods for plant production, and semen and embryo cryopreservation for livestock reproduction, could be expanded and improved.
- Ukraine needs to increase its links with Europe in many areas, including research and development but also commerce.

## **12. References**

APHD (Agricultural Policy for Human Development Project), Kiev 2002. Agricultural Policy in Ukraine: Analysis and Research 1999-2002. UNDP, USAID, The World Bank. pp. 427.

APHD (Agricultural Policy for Human Development Project), Kiev 2003. Agricultural Policy in Ukraine: Analysis and Research 2002-2003. UNDP, USAID, The World Bank. pp. 470.

APHD (Agricultural Policy for Human Development Project), Kiev 2004. Agricultural Policy in Ukraine: Analysis and Research 2003-2004. UNDP, USAID, The World Bank. pp. 447.

IBRD/World Bank, 2004. Achieving Ukraine's Agricultural Potential: Stimulating Agricultural Growth and Improving Rural Life – Joint Publication by OECD and The World Bank. Washington, DC.

Agroecological Journal, 2005, 1: 3-7. (in Ukrainian)

Anonim – Information on crop and livestock production in Ukraine from the Ministry of Agricultural Policy 2004.

Biotech. Letter., 1996, 18: 1309-1314.

Genetica, 2000, 36, 1: 44-51. (in Russian)

Izpolzovanie PCR –analiza v genetiko-selektzionnykh issledovanyakh. Kiev. Agrarna Nauka. 1998. (in Ukrainian)

Katalog embrioniv velikoy rohatoy khudoby, 2003-2004. (in Ukrainian)

Messenger of Agricultural Sciences, 1998, 4: 37-41

Physiol. Biochem. Cult. Plants, 2003, 35 (11)

Plant Cell Reports, 2003, 21 (6): 503-510

Profesor Glazko Valeryi Ivanovitz. Bibliography. Agrarna Nauka. Kiev. 2004: 78-101.

Russian J. Genetics, 1996, 32: 1104-1111

Russian J. Genetics, 2004, 40, 1: 49-55

### **Selected websites:**

Agri-Food Country Profile Ukraine, August 2002  
<http://atn-riac.agr.ca/europe/e2200.htm>

Agro Web Ukraine  
<http://awu.kiev.ua>

Country Pasture/Forage Resources Profiles. Ukraine  
<http://www.fao.org/ag/AGP/AGPC/doc/Counprof/ukraine.htm>

FAOBioDeC Biotechnology in Developing Countries  
[www.fao.org/biotech/inventory\\_admin/dep/default.asp](http://www.fao.org/biotech/inventory_admin/dep/default.asp)

GEF/UNDP The Black Sea Ecosystem Recovery Project (BSERP)

<http://www.blacksea-environment.org>

Institute of Cell Biology and Genetic Engineering, National Academy of Science of Ukraine

[http://www.icbge.org.ua/ICBGE/index\\_en.htm](http://www.icbge.org.ua/ICBGE/index_en.htm)

National Academy of Sciences of Ukraine

<http://www.nas.gov.ua/En/main.html>

State Service on Right Protection for Plant Varieties

[http://www.sops.gov.ua/index.en.htm`](http://www.sops.gov.ua/index.en.htm)

The International Portal on Food Safety, Animal & Plant Health

<http://www.ipfsaph.org>

The European Network of GMO Laboratories

<http://engl.jrc.it>

UNEP/GEF Biosafety Projects, Ukraine

<http://www.unep.ch/biosafety/partcountries/UAcountrypage.htm>

Ukraine report on biosafety by Ministry for the Environmental Protection of Ukraine

<http://www.biodiv.org/doc/world/ua/ua-nr-cpbi-en.pdf>

Ukrainian Academy of Agricultural Sciences

<http://www.aginukraine.com/UAAS/index.html>

Ukrainian laboratory of quality and safety of AIC products

<http://www.qualitylab.com.ua/en/>

Yaroslav the Wise Institute of Legal Information

<http://www.welcometo.kiev.ua/pls/ili/ili.home>

## Annex 1. Data for FAO-BioDeC - Plants

<i>Region</i>	<i>Country</i>	<i>Intervention</i>	<i>Type</i>	<i>Sub Type</i>	<i>Details</i>	<i>Species</i>	<i>Level of Achievement</i>	<i>Start Date</i>	<i>End Date</i>	<i>Institution</i>	<i>Background documents</i>	<i>Source of Information</i>	<i>International Partnerships</i>
Europe	UKR	GMO	Herbicide tolerant	Roundup Ready	glyphosate	maize (GA21)	field trial, state testing	1998		Monsanto,	personal communication	EFI Monsanto, Ukraine, Monsanto imagine	US commercial company
Europe	UKR	GMO	Insect resistance	Bt		maize	field trial	1998		DeKalb/Monsanto		Brochure of UNEP-GFE project, Ostapenko, 2004	US and European commercial companies
Europe	UKR	GMO	Herbicide	Roundup Ready	glyphosate	sugar beet	field trial, state testing	1998		Monsanto/Novartis (currently Syngenta)	personal communication	EFI Monsanto, Ukraine, Monsanto imagine	US and European commercial companies
Europe	UKR	GMO	Herbicide	Liberty Link	glufosinate ammonium	sugar beet	field trial	1998		KWS/ Bayer (formerly Aventis Crop Science)		Brochure of UNEP-GFE project, Ostapenko, 2004	
Europe	UKR	GMO	Herbicide	Liberty Link	phosphotricin	winter and spring oil rape	field Trial	1998		Bayer (formerly Aventis)		Brochure of UNEP-GFE project, Ostapenko, 2004	
Europe	UKR	GMO	Insect resistance	Lepidoptera	Bt, Colorado Potato Beetle	potato cv. New Leaf Russet Burbank	field trials, state testing	1997	1998	Monsanto	personal communication	EFI Monsanto, Ukraine, Monsanto imagine	US commercial company
Europe	UKR	GMO	Insect resistance	Lepidoptera	Bt, Colorado Potato Beetle	potato cv. New Leaf Superior	field trials, state testing	1997	1998	Monsanto	personal communication	EFI Monsanto, Ukraine, Monsanto imagine	US commercial company
Europe	UKR	GMO	Insect resistance	Lepidoptera	Bt, Colorado Potato Beetle	potato, cv. New Leaf Atlantic	field trials, state testing	1997	1998	Monsanto	personal communication	EFI Monsanto, Ukraine, Monsanto imagine	US commercial company

<i>Region</i>	<i>Country</i>	<i>Intervention</i>	<i>Type</i>	<i>Sub Type</i>	<i>Details</i>	<i>Species</i>	<i>Level of Achievement</i>	<i>Start Date</i>	<i>End Date</i>	<i>Institution</i>	<i>Background documents</i>	<i>Source of Information</i>	<i>International Partnerships</i>
Europe	UKR	GMO	Insect resistance	Lepidoptera	Bt, Colorado Potato Beetle	potato (Ukrainian cvs)	greenhouse experiments	2005		Potato Research Institute, UAAS	personal communication		past collaboration with Russia
Europe	UKR	GMO	Pathogen resistant	Fungi	defensine	potato	greenhouse experiments	2005		Potato Research Institute, UAAS	personal communication		past collaboration with Russia
Europe	UKR	Techniques	Cell Biology	Somatic fusion	cms lines	carrot	established			International Institute of Cell Biology, Kiev		<a href="http://www.icbge.org.ua">www.icbge.org.ua</a>	commercial service on
Europe	UKR	Techniques	Cell Biology	Somatic fusion	cms lines	tomato	established			International Institute of Cell Biology, Kiev		<a href="http://www.icbge.org.ua">www.icbge.org.ua</a>	commercial service on
Europe	UKR	Techniques	Cell Biology	Micropropagation	virus free plants	grapevine	established planting stocks			International Institute of Cell Biology, Kiev		<a href="http://www.icbge.org.ua">www.icbge.org.ua</a>	commercial service on
Europe	UKR	GMO				tobacco	field trial			International Institute of Cell Biology, Kiev		<a href="http://www.icbge.org.ua">www.icbge.org.ua</a>	commercial service on
Europe	UKR	GMO				potato	field trial			International Institute of Cell Biology, Kiev		<a href="http://www.icbge.org.ua">www.icbge.org.ua</a>	commercial service on
Europe	UKR	GMO				tomato	field trial			International Institute of Cell Biology, Kiev		<a href="http://www.icbge.org.ua">www.icbge.org.ua</a>	commercial service on
Europe	UKR	GMO	Quality trait	Sugars Composition		pea	field trial			International Institute of Cell Biology, Kiev		<a href="http://www.icbge.org.ua">www.icbge.org.ua</a>	commercial service
Europe	UKR	Techniques	Cell Biology	Plantlets regeneration from calli, protoplast isolation		finger millet ( <i>Eleusine coracana</i> )	established	2004		Institute of Cell Biology and Genetic Engineering	Plant Cell Reports, 2004		
Europe	UKR	Techniques	Cell Biology	Somatic embryogenesis and regeneration	herbicide tolerant (dinitroaniline)	Goosegrass ( <i>Eleusine indica</i> )	established	2003		Institute of Cell Biology and Genetic Engineering	Plant Cell Reports 2003, 21 (6)		
Europe	UKR	Techniques	Cell Biology	Calli cultures	taxol biosynthesis - <i>Taxus baccata</i> L.	Common yew ( <i>Taxus baccata</i> )	established	1996		Institute of Cell Biology and Genetic Engineering	Biotech. Letter., 1996, 18		

<i>Region</i>	<i>Country</i>	<i>Intervention</i>	<i>Type</i>	<i>Sub Type</i>	<i>Details</i>	<i>Species</i>	<i>Level of Achievement</i>	<i>Start Date</i>	<i>End Date</i>	<i>Institution</i>	<i>Background documents</i>	<i>Source of Information</i>	<i>International Partnerships</i>
Europe	UKR	GMO		Nisin biosynthesis genes		<i>Brassicaceae</i>	established	2000		Institute of Cell Biology and Genetic Engineering	Ph. D. thesis, Radchuk 2000		
Europe	UKR	GMO	Herbicide	Dinitroaniline		soybean	established			Institute of Cell Biology and Genetic Engineering	Ph. D. thesis, Pakhomov		
Europe	UKR	Techniques	Cell Biology	Somatic embryogenesis and regeneration	wind - tolerant	flax	established	2003		Institute of Cell Biology and Genetic Engineering	Physiol. Biochem.Cult.Plants, 35,(11)		
Europe	UKR	Techniques	Cell Biology	Cell lines selection	cadmium resistant	<i>Nicotiana plumbaginifolia</i>	established	2004		Institute of Cell Biology and Genetic Engineering	Rus. J. Plant Physiol., 2004		
Europe	UKR	Techniques	Cell Biology	Somatic hybridization	resistance to antimicrotubule compounds	<i>Solanaceae, N. plumbaginifolia</i>	established	1996		Institute of Cell Biology and Genetic Engineering	Rus. J. Genetics, 1996, 32		
Europe	UKR	Techniques	Diagnostics	Real time PCR	GMO detection	food	ongoing			Institute of Cell Biology and Genetic Engineering	personal communication		
Europe	UKR	Techniques	Meristem Culture	Virus eradication	virus free plantlets	potato	commercialization			Potato Research Institute, UAAS	personal communication		
Europe	UKR	Techniques	Cell Biology	Micropropagation	virus free plantlets, minitubers	potato	commercialization			Potato Research Institute, UAAS	personal communication		
Europe	UKR	Techniques	Cell Biology	Somaclonal variation	callus cultures, yield ability	potato	greenhouse experiments	2005		Potato Research Institute, UAAS	personal communication		
Europe	UKR	Techniques	Cell Biology	Somaclonal variation	heat and drought tolerance	potato	in vitro experiments	2005		Potato Research Institute, UAAS	personal communication		
Europe	UKR	Techniques	Cell Biology	Somaclonal variation	resistance to bacteria	potato	in vitro experiments	2005		Potato Research Institute, UAAS	personal communication		

<i>Region</i>	<i>Country</i>	<i>Intervention</i>	<i>Type</i>	<i>Sub Type</i>	<i>Details</i>	<i>Species</i>	<i>Level of Achievement</i>	<i>Start Date</i>	<i>End Date</i>	<i>Institution</i>	<i>Background documents</i>	<i>Source of Information</i>	<i>International Partnerships</i>
Europe	UKR	GMO	GUS	Variation among cultivars	GUS expression	potato	field trial			Institute of Agroecology and Biotechnology, UAAS	personal communication		
Europe	UKR	GMO	Insect resistance	Bt plants	microevolution of insect populations	potato	ongoing	2005		Institute of Agroecology and Biotechnology, UAAS	personal communication		
Europe	UKR	GMO	Insect resistance	Bt plants	microevolution of insect populations	maize	ongoing	2005		Institute of Agroecology and Biotechnology, UAAS	personal communication		
Europe	UKR	Techniques	Diagnostics	RT-PCR	PSTVd	potato	established			Institute of Agroecology and Biotechnology, UAAS	personal communication		
Europe	UKR	Techniques	Diagnostics	PCR	GMO detection	soybean	ongoing			Institute of Agroecology and Biotechnology, UAAS	personal communication		
Europe	UKR	GMO	Morphology	Growth		wheat	established			Plant Breeding and Genetics Institute, UAAS	personal communication		Rothamsted Ex. Station, GB
Europe	UKR	GMO	Quality trait	Backing value	overexpression of gluten genes	wheat	ongoing	2002		Plant Breeding and Genetics Institute, UAAS	personal communication		West. Reg. Res. Center, USDA, Albany, CA, USA
Europe	UKR	Techniques	Cryoconservation	Gene bank	pathogenic fungi collection	Fungi pathogenic to cereals	established			Plant Breeding and Genetics Institute, UAAS	personal communication		
Europe	UKR	Techniques	Embryo rescue	in vitro culture of interspecific hybrids	introgression of alien genes	wheat x <i>Agropyron</i>	established			Plant Breeding and Genetics Institute, UAAS	personal communication		

<i>Region</i>	<i>Country</i>	<i>Intervention</i>	<i>Type</i>	<i>Sub Type</i>	<i>Details</i>	<i>Species</i>	<i>Level of Achievement</i>	<i>Start Date</i>	<i>End Date</i>	<i>Institution</i>	<i>Background documents</i>	<i>Source of Information</i>	<i>International Partnerships</i>
Europe	UKR	Techniques	Embryo rescue	in vitro culture of interspecific hybrids	introgression of alien genes	wheat x <i>Haynaldia villosa</i>	established			Plant Breeding and Genetics Institute, UAAS	personal communication		
Europe	UKR	Techniques	Genetic Markers	ISSR, SSR	linked to genes of vernalization response: vrn1, ppd1A,	winter wheat	established			Plant Breeding and Genetics Institute, UAAS	personal communication		
Europe	UKR	Techniques	Cell Biology	Anther cultures	doubled haploids	barley	established			Plant Breeding and Genetics Institute, UAAS	personal communication		
Europe	UKR	Techniques	Genetic Markers	RAPD, ISSR	linked to QTL of winter hardness	wheat	established			South Plant Biotechnology Center, UAAS & MES	personal communication		
Europe	UKR	Techniques	Genetic Markers	RAPD, ISSR	linked to yield heterosis	maize	ongoing			South Plant Biotechnology Center, UAAS & MES	personal communication		
Europe	UKR	Techniques	Genetic Markers	RAPD, Microsatellites	genotype identification	wheat	ongoing			South Plant Biotechnology Center, UAAS & MES	personal communication	Genetica, 2000, 36 (1)	
Europe	UKR	Techniques	Genetic Markers	Microsatellites	genotype identification	barley	ongoing			South Plant Biotechnology Center, UAAS & MES	personal communication		
Europe	UKR	Techniques	Genetic Markers	Microsatellites	genotypes identification	sunflower	ongoing			South Plant Biotechnology Center, UAAS & MES	personal communication		

<i>Region</i>	<i>Country</i>	<i>Intervention</i>	<i>Type</i>	<i>Sub Type</i>	<i>Details</i>	<i>Species</i>	<i>Level of Achievement</i>	<i>Start Date</i>	<i>End Date</i>	<i>Institution</i>	<i>Background documents</i>	<i>Source of Information</i>	<i>International Partnerships</i>
Europe	UKR	Techniques	Genetic Markers	RAPD, isozymes	genotypes identification	apricot	established			South Plant Biotechnology Center, UAAS & MES	personal communication		
Europe	UKR	Techniques	Genetic Markers	STS	linked to restorer gene Rf of male sterility	sunflower	ongoing			South Plant Biotechnology Center, UAAS & MES	personal communication		
Europe	UKR	Techniques	Genetic Markers	SSR	linked to gene of resistance to fungal diseases originated from <i>Aegilops cylindrical</i>	wheat x <i>Aegilops</i> hybrids	ongoing			South Plant Biotechnology Center, UAAS & MES	personal communication		
Europe	UKR	Techniques	Genetic Markers	RAPD	cultivars identification, genetic distance	barley	ongoing			South Plant Biotechnology Center, UAAS & MES	personal communication		
Europe	UKR	Techniques	Cell Biology	Anther culture	doubled haploids	wheat	established			South Plant Biotechnology Center, UAAS & MES	personal communication		
Europe	UKR	Techniques	Cell Biology	Anther culture	doubled haploids	barley	established			South Plant Biotechnology Center, UAAS & MES	personal communication		
Europe	UKR	Techniques	Cell Biology	Anther culture	doubled haploids	Triticale	established			South Plant Biotechnology Center, UAAS & MES	personal communication		

<i>Region</i>	<i>Country</i>	<i>Intervention</i>	<i>Type</i>	<i>Sub Type</i>	<i>Details</i>	<i>Species</i>	<i>Level of Achievement</i>	<i>Start Date</i>	<i>End Date</i>	<i>Institution</i>	<i>Background documents</i>	<i>Source of Information</i>	<i>International Partnerships</i>
Europe	UKR	Techniques	Embryo rescue culture	Interspecific hybrids		wheat	established			South Plant Biotechnology Center, UAAS & MES	personal communication		
Europe	UKR	Techniques	Embryo rescue culture	Interspecific hybrids		barley	established			South Plant Biotechnology Center, UAAS & MES	personal communication		
Europe	UKR	Techniques	Genetic Markers	SSR	genotype identification, 2 loci/chromosome	maize	established			South Plant Biotechnology Center, UAAS & MES	personal communication	Russian J. Genetics, 2004, 40 (1)	
Europe	UKR	Techniques	Genetic Markers	RAPD, ISSR, STS	pathogen populations	<i>Fusarium</i> species	ongoing			South Plant Biotechnology Center, UAAS & MES	personal communication		
Europe	UKR	Techniques	Cell Biology	Micropropagation		<i>Arnica foliosa</i>	established			South Plant Biotechnology Center, UAAS & MES	personal communication		
Europe	UKR	Techniques	Cell Biology	Micropropagation		alfalfa	established			South Plant Biotechnology Center, UAAS & MES	personal communication		
Europe	UKR	Techniques	Cell Biology	Micropropagation		<i>Medicago</i> spp.	established			South Plant Biotechnology Center, UAAS & MES	personal communication		
Europe	UKR	Techniques	Cell Biology	Micropropagation		<i>Glycine max</i>	established			South Plant Biotechnology Center, UAAS & MES	personal communication		

<i>Region</i>	<i>Country</i>	<i>Intervention</i>	<i>Type</i>	<i>Sub Type</i>	<i>Details</i>	<i>Species</i>	<i>Level of Achievement</i>	<i>Start Date</i>	<i>End Date</i>	<i>Institution</i>	<i>Background documents</i>	<i>Source of Information</i>	<i>International Partnerships</i>
Europe	UKR	Techniques	Cell Biology	Micropropagation	virus free plantlets	hop	established			Department of Ecobiotechnology, NAUU	personal communication		
Europe	UKR	Techniques	Cell Biology	Micropropagation	virus free	potato	established			Department of Ecobiotechnology, NAUU	personal communication		
Europe	UKR	Techniques	Cell Biology	Micropropagation		Petunia	established			Department of Ecobiotechnology, NAUU	personal communication		
Europe	UKR	Techniques	Cell Biology	Micropropagation		Surfinia	established			Department of Ecobiotechnology, NAUU	personal communication		
Europe	UKR	Techniques	Cell Biology	Micropropagation	virus free	grapevine	established			Department of Ecobiotechnology, NAUU	personal communication		
Europe	UKR	Techniques	Diagnostics	Virus eradication	ELISA, PCR, electron microscopy	hop, potato, grapevine	established			Department of Ecobiotechnology, NAUU	personal communication		
Europe	UKR	Techniques	Cell Biology	Protoplast fusion		tobacco	established			Department of Ecobiotechnology, NAUU	personal communication		
Europe	UKR	Techniques	Cell Biology	Protoplast fusion		tomato	established			Department of Ecobiotechnology, NAUU	personal communication		
Europe	UKR	Techniques	Genetic Markers	RAPD	genotypes identification	hop cultivars	established			Department of Ecobiotechnology, NAUU	personal communication		
Europe	UKR	Techniques	Genetic Markers	RAPD	genotypes identification	sugar beet cultivars	established			Department of Ecobiotechnology, NAUU	personal communication		
Europe	UKR	GMO	Pathogen resistance	Virus	cp AMV	beans	ongoing			Department of Ecobiotechnology, NAUU	personal communication		

<i>Region</i>	<i>Country</i>	<i>Intervention</i>	<i>Type</i>	<i>Sub Type</i>	<i>Details</i>	<i>Species</i>	<i>Level of Achievement</i>	<i>Start Date</i>	<i>End Date</i>	<i>Institution</i>	<i>Background documents</i>	<i>Source of Information</i>	<i>International Partnerships</i>
Europe	UKR	GMO	Pathogen resistance	Virus	cp AMV	pea	ongoing			Department of Ecobiotechnology, NAUU	personal communication		
Europe	UKR	Diagnostics	Real time PCR		GMO detection	plant material, plant products	ongoing			Laboratory of Quality and Safety of Agricultural Products, NAUU	personal communication		

## Annex 2. Data for FAO-BioDeC - Animals

<i>Region</i>	<i>Country</i>	<i>Intervention</i>	<i>Type</i>	<i>Sub Type</i>	<i>Details</i>	<i>Species</i>	<i>Level of Achievement</i>	<i>Start Date</i>	<i>End Date</i>	<i>Institution</i>	<i>Background documents</i>	<i>Source of Information</i>	<i>International Partnerships</i>
Europe	UKR	Techniques	Reproduction	Artificial insemination		cows	commercial	1960.		state and private veterinarian service	personal communication		
Europe	UKR	Techniques	Reproduction	Cryoconservation	semen	bulls, pigs	commercial	1960.		state and private veterinarian service	personal communication		
Europe	UKR	Techniques	Reproduction	Artificial insemination		pigs, horses	commercial			state and private veterinarian service	personal communication		
Europe	UKR	Techniques	Reproduction	Embryo transfer		cattle	commercial	1960.		Main Selection Center of Ukraine, The Institute of Animal Breeding and Genetics			USA, Canada, Italy, Austria
Europe	UKR	Techniques	Reproduction	Embryo transfer		pigs	experimental	1998		The Institute of Animal Breeding and Genetics	Messenger of agricultural sciences”, 1998,4:37-41		
Europe	UKR	Techniques	Reproduction	Embryo transfer		horses, goats, sheep	experimental			The Institute of Animal Breeding and Genetics			
Europe	UKR	Techniques	Reproduction	Cryoconservation	embryos/vitrification	Cattle, pigs	commercial			Main Selection Center of Ukraine; "Bolshevik JSC” of Donetsk province	Catalogue embyonov velikoy rohatoy chudoby, 2003-2004.		USA, Canada, Italy, Austria

<i>Region</i>	<i>Country</i>	<i>Intervention</i>	<i>Type</i>	<i>Sub Type</i>	<i>Details</i>	<i>Species</i>	<i>Level of Achievement</i>	<i>Start Date</i>	<i>End Date</i>	<i>Institution</i>	<i>Background documents</i>	<i>Source of Information</i>	<i>International Partnerships</i>
Europe	UKR	Techniques	Reproduction	In vitro maturation	In vitro fertilization (IVF)	cattle	commercial			Main Selection Center of Ukraine, The Institute of Animal Breeding and Genetics			
Europe	UKR	Techniques	Reproduction	In vitro maturation	In vitro fertilization (IVF)	pigs	advanced experiments			The Institute of Animal Breeding and Genetics	personal communication		
Europe	UKR	Techniques	Reproduction	In vitro maturation	In vitro fertilization (IVF)	sheep	experimental			The Institute of Animal Breeding and Genetics			Institute of Zoology in Krakow, Poland
Europe	UKR	Techniques	Reproduction	sexing embryos	PCR	Cattle	experimental			Laboratory of Quality and Safety of Agricultural Products, NAUU			
Europe	UKR	Techniques	Diagnostics	PCR, ELISA	cattle diseases	Leucosis, tuberculosis, brucellosis, chlamydia, etc.	commercial			Institute of Agroecology and Biotechnology, UAAS			
Europe	UKR	Techniques	dDiagnostics	PCR	cattle diseases	Bovine leucose DNA provirus BLV	experimental						
Europe	UKR	Techniques	Genetic markers	PCR	stress gene	Pigs	experimental			The Institute of Animal Breeding and Genetics; Institute of Agroecology and Biotechnology, UAAS			

<i>Region</i>	<i>Country</i>	<i>Intervention</i>	<i>Type</i>	<i>Sub Type</i>	<i>Details</i>	<i>Species</i>	<i>Level of Achievement</i>	<i>Start Date</i>	<i>End Date</i>	<i>Institution</i>	<i>Background documents</i>	<i>Source of Information</i>	<i>International Partnerships</i>
Europe	UKR	Techniques	Genetic markers	PCR	kappa-casein in milk (CNS)	cattle	experimental			The Institute of Animal Breeding and Genetics, UAAS ;Institute of Agroecology and Biotechnology, UAAS			
Europe	UKR	Techniques	Cytological markers	Cytology	Chromosome Y of Zebu type	cattle	experimental			The Institute of Animal Breeding and Genetics			
Europe	UKR	Techniques	Protein markers	isozymes	genetic identification of the origin	cattle, fish	experimental			The Institute of Animal Breeding and Genetics			
Europe	UKR	Techniques	Cytogenetics	chromosomal mutations	genetic identification of the origin	cattle, pigs, horses, fish	experimental			The Institute of Animal Breeding and Genetics			
Europe	UKR	Techniques	Molecular markers	ISSR	genetic identification of the origin	cattle, pigs, horses, fish	experimental			Institute of Agroecology and Biotechnology, UAAS			
Europe	UKR	Techniques	Molecular markers	PCR	somatotropin locus (ST)	cattle	experimental			Institute of Agroecology and Biotechnology, UAAS			
Europe	UKR	GMO	Quality	Lac Z	structural genes expression	rabbit	experimental			Institute of Agroecology and Biotechnology, UAAS			Institute of Animal Genetics, PAS, Poland

