
Food and Agriculture

Objective

To contribute to the sustainable intensification of agricultural production and the improvement of global food security through capacity building and technology transfer to Member States. To increase the resilience of livelihoods to threats and crises that impact agriculture, including climate change, biothreats, food safety risks, and nuclear or radiological emergencies. To improve efficient agricultural and food systems for sustainable management and conservation of natural resources, and to enhance the conservation and application of plant and animal biodiversity.

Emergency Response to Transboundary Animal Disease Outbreaks

At the request of Member States affected by African swine fever — Cambodia, China, Indonesia, the Lao People’s Democratic Republic, Malaysia, Mongolia, Myanmar, Thailand and Viet Nam — the Agency delivered unprecedented technical assistance and on the ground support to control the spread of the disease. Through the Animal Production and Health Laboratory and the Veterinary Diagnostic Laboratory (VETLAB) Network, it strengthened the affected countries’ diagnostic capabilities by providing emergency toolkits and laboratory equipment to detect the virus and related antibodies, training for laboratory technical staff, policy advice and on the ground technical support. The prompt action of the Agency not only helped the swine industry and trade, it also eased the effect of this disease on livelihoods.

In West and Central Africa, several countries were hit by an outbreak of the equine influenza that killed over 300 000 donkeys in the Niger alone. The Agency, through the VETLAB Network, distributed reagents and reference material for rapid diagnosis and surveillance to national laboratories in Burkina Faso, Cameroon, Ghana, Morocco, the Niger, Nigeria and Senegal, strengthening their capacity to detect and monitor the spread of the disease. The Agency also supported Ethiopia and South Africa with up to date laboratory techniques to detect the strain of the avian influenza and determine its pathogenic level for poultry, other animals and humans (Fig. 1). For the first time, the Animal Production and Health Laboratory developed an irradiated vaccine prototype against avian influenza, which compares favourably with vaccines developed through traditional methods.

“For the first time, the Animal Protection and Health Laboratory developed an irradiated vaccine prototype against avian influenza”

Food Safety

The Agency, through the Food and Environmental Protection Laboratory, continued to develop, test and validate advanced nuclear and related analytical methods for the detection and control of chemical residues and contaminants in various food resources. These research activities led to the elaboration of international standards for the determination



FIG. 1. The IAEA VETLAB Network helps scientists in Cameroon to prevent and control African Swine fever in small commercial pig farms.

of pesticide residues, environmental pollutants, aflatoxin and other contaminants in commercially important food and plants. Major achievements included the development and validation of a multicontaminant analysis method for *Curcuma longa* (turmeric) – an economically important food and medicinal spice. The method was also adapted to determine pesticide residues in the leaves of a medicinal and herbal plant widely used in Latin America, *Peumus boldus* (boldo). The availability of efficient methods to determine contaminants known for their carcinogenicity, such as harmful pesticides and dyes, is a key contribution to food safety and food quality. The Agency also supported Member States to streamline the use of analytical and biomonitoring methodologies targeting high impact pesticides in food and the environment. As a result, Member States enhanced their testing capabilities for emerging contaminants in food and agriculture such as nicotine and drug residues. In July, the Agency launched a new CRP to support Member States' generation of scientific evidence for safe levels of veterinary drug residues in food products.

Sterile Insect Technique to Control Human Disease Vectors

The Agency, through the Insect Pest Control Laboratory, has furthered the testing, validation and operationalization of the sterile insect technique (SIT) to control disease-transmitting mosquitoes such as *Aedes aegypti* and *A. albopictus*, the vectors for dengue, chikungunya, Zika and yellow fever. Activities focused on moving from small-scale validation field trials in Greece and Italy to large-scale operational field trials in China, Mexico and Singapore. The Agency developed innovative operational solutions, including enhanced efficiency of the drone system used to release sterile male mosquitoes, improved quality control of the sterile male mosquitoes for flight ability, and the adaptation of a phased conditional approach for SIT deployment. This adapted approach ensures that SIT projects progress through a series of steps, starting with baseline data collection, followed by small-scale field trials, pre-operational testing and operational intervention. To strengthen joint actions on SIT against human disease vector mosquitoes,

the Agency signed a memorandum of understanding with WHO to intensify collaboration on the development and use of SIT against *Aedes* mosquitoes. This led to a joint mission to Bangladesh to assess a dengue outbreak and develop a plan to test a nuclear technique to suppress the mosquitoes responsible for the disease upsurge.

Addressing Crop Diseases with Mutation Breeding

The Agency facilitated important research and development advances to identify disease resistant crops using mutation breeding techniques. Key developments included the confirmation of rice mutant lines with resistance to the parasitic weed *Striga asiatica* and the identification of banana with resistance to Fusarium wilt caused by the tropical race 4 (TR4) strain of *Fusarium oxysporum* f. sp. *cubense*. The former was achieved through the use of laboratory and greenhouse based precision phenotyping protocols developed at the Agency's Plant Breeding and Genetics Laboratory, while the latter was the result of the combination of tissue culture and efficient disease screening procedures conducted at the Guangdong Academy of Agricultural Sciences in China under the CRP entitled 'Efficient Screening Techniques to Identify Mutants with Disease Resistance for Coffee and Banana'. This TR4 resistant banana variety is now being multiplied for field trials across TR4 infected banana growing regions in China (Fig. 2). This unprecedented breakthrough against transboundary plant diseases is a crucial milestone in improving mutation induction in coffee and banana, which are key for the economies and food security of many Member States.



FIG. 2. Mutation breeding is helping to combat Fusarium wilt (TR4), a disease that is wiping out swathes of banana plantations in Asia, Africa and more recently Latin America.

Human Health

Objective

To enhance Member State capability to address needs relating to the prevention, diagnosis and treatment of health problems through the development and application of nuclear and related techniques within a quality assurance framework.

Roadmap for Cancer Care and Control

Governments worldwide face the challenge of providing quality care to address the growing burden of cancer. The Agency and WHO jointly developed the Roadmap towards a National Cancer Control Programme to help countries set milestones for establishing nuclear medicine, diagnostic imaging and radiotherapy services. The Roadmap draws on the Agency's nuclear and radiation related expertise and WHO's guidance on developing blueprints for effective programmes on the ground. It provides guidance on implementing services relating to cancer prevention, diagnosis, treatment and palliative care. Along with guiding Member States on the establishment of radiation medicine services and providing guidance documents, the Roadmap also covers questions relating to nuclear safety and legal considerations.

New Linear Accelerator Facility at the Dosimetry Laboratory

A clinical linear accelerator (linac) was installed at the Agency's Dosimetry Laboratory in Seibersdorf, Austria (Fig. 1). In December, a customized robotic arm was installed in the linac bunker, to be used as a platform for performing calibrations. The linac facility will be used for training, audits, calibration of ionization chambers, and research and development in dosimetry.

International Virtual Conference on Theranostics

Recent developments in positron emission tomography, especially the use of fluorine-18 fluorodeoxyglucose and new approaches to targeted radionuclide therapies, have paved the way for more personalized cancer management. The first International Virtual Conference on Theranostics discussed how the integration of diagnostic molecular imaging with radionuclide therapies is key to individualized management of disease. Over 1000 participants from 104 Member States participated remotely, and 393 participants from 79 Member States completed the requirements necessary to be awarded continuing medical education credits. This was the first time that the European Union of Medical Specialists awarded credits to participants of a virtual initiative.



FIG. 1. The new linear accelerator facility at the Dosimetry Laboratory, visit by the Director General.

Transforming Health Care with Nuclear Techniques

Tissue engineering is poised to revolutionize the field of regenerative medicine by shifting the treatment focus from mitigating symptoms or causes to repairing and regenerating tissue — leading to full recovery. The Agency completed a five year CRP entitled ‘Instructive Surfaces and Scaffolds for Tissue Engineering Using Radiation Technology’. The main aim of the project, which succeeded in producing both the surfaces and scaffolds and artificial tissue for use in regenerative medicine, was to make this technology available worldwide (Fig. 2). The 15 institutions from 14 Member States that participated in the CRP are now ready to implement the new technology.

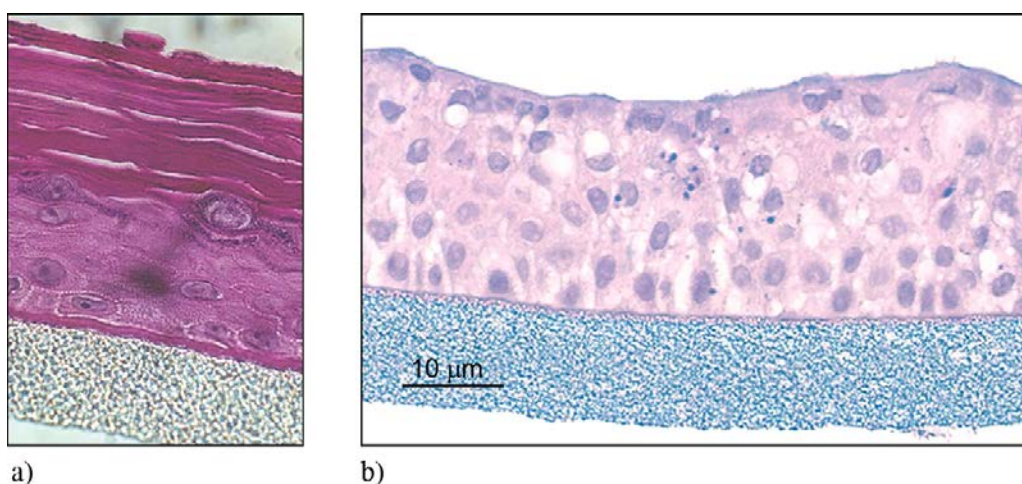


FIG. 2. Artificial skin human tissue system (a) and artificial tracheal/bronchial epithelial human tissue system (b) produced as part of a CRP aimed at making tissue engineering technology available worldwide.

Directory of Radiotherapy Centres (DIRAC) Update

Created by the Agency in 1959, DIRAC is the world's most comprehensive database on radiotherapy resources. It comprises current and historical global data on radiotherapy centres, teletherapy machines, brachytherapy units, treatment planning systems, computed tomography systems and simulators. Quality Assurance Team for Radiation Oncology (QUATRO) missions, coordinated research and technical cooperation projects, educational resources, partnerships and the results of surveys are linked in DIRAC. DIRAC is now also fully integrated with the International Dose External Audits database, a resource that maintains data on dose quality audits for hospitals. The newly developed option to add comments will help the Agency retain historical data, contacts and valuable metadata.