Food and Agriculture

Objective

To contribute to sustainable intensification of agricultural production and the improvement of global food security by addressing the challenges of food production, food protection and food safety through capacity building in and technology transfer to Member States.

Sustainable Management of Major Insect Pests

The Agency supports around forty field projects involving the application of the sterile insect technique (SIT). Among these is a project in Senegal that has improved food security and public health in target areas in the western part of the country. At Expo Milano 2015, this tsetse eradication project was selected from among 749 projects as one of the 18 Best Sustainable Development Practices on Food Security for its contribution to furthering sustainable development of small rural communities in marginal areas.

The Agency also supported the application of SIT to control the Mediterranean fruit fly in the Latin America and the Caribbean region during the year. After a large outbreak was detected in the Dominican Republic, importers of Dominican horticultural products closed their markets, leading to major economic losses. The country's Ministry of Agriculture launched an emergency response programme in early 2015, with the Agency, the Food and Agriculture Organization of the United Nations (FAO) and other partners providing extensive technical assistance. As a result, the expanding outbreak was contained during the year; a major eradication campaign is under way, involving the release of sterile male insects to completely eliminate this pest.

The stable fly (*Stomoxys calcitrans*) affects the Costa Rican livestock industry, causing major losses of animal productivity. The proliferation of the stable fly, which grows on pineapple residues from large farms, has become a serious problem. In 2015, a technical cooperation project was implemented to develop capacities at the National Institute of Agricultural Technology Innovation and Transfer in Costa Rica to address the issue. The Agency worked with Costa Rican counterparts to build capacity to mass rear *Spalangia endius* wasps as a means of biological pest control. *Spalangia endius* is a parasite of the stable fly and naturally suppresses stable fly populations. The wasps are produced on irradiated stable fly larvae so that larvae that are not parasitized cannot become fertile flies when released together with the parasitoids.

During the year, a coordinated research project (CRP) entitled 'Resolution of Cryptic Species Complexes of Tephritid Pests to Overcome Constraints to the Application of the Sterile Insect Technique and International Trade' was completed. The results of the CRP, which studied African, Asian and Latin American fruit fly cryptic pest complexes, were published in a special issue of the peer-reviewed scientific journal *ZooKeys* (Fig. 1).

FIG. 1. Fruit fly cryptic species: South American fruit fly, Anastrepha fraterculus *(A), Natal fruit fly,* Ceratitis rosa *(B), melon fly,* Zeugodacus cucurbitae *(C), Oriental fruit fly,* Bactrocera dorsalis *(D). (Photographs courtesy of: (A) Michal Hoskovec; (B) and (C) Antoine Franck; and (D) Ana Rodriguez.)*

Animal Production and Health

The Agency continued its contributions to strengthening regional capacities for early detection of emerging and re-emerging zoonotic diseases in wildlife and livestock, and the establishment of early warning systems. Particular attention was given to the Ebola virus disease (EVD) and the highly pathogenic H5N1 avian influenza. During the year, the Agency's Board of Governors approved an off-cycle technical cooperation project targeting emerging zoonotic diseases (including EVD), and additional reserve fund projects were approved to provide targeted support to Burkina Faso, Côte d'Ivoire, Ghana, Niger and Nigeria on H5N1. These activities received strong technical and financial support from the Peaceful Uses Initiative (PUI) and the African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (AFRA).

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Globally, outbreaks of H5N1 have killed millions of birds, and 60% of all humans infected with this deadly virus have died. In early 2015, a highly pathogenic H5N1 strain re-emerged in western Africa. In response to requests by Member States in the region, the Agency provided support through the Veterinary Diagnostic Laboratory (VETLAB) network of veterinary institutions and laboratories and through the technical cooperation programme.

Expert missions including staff of the Joint FAO/IAEA Division, together with external avian influenza experts, were sent to Burkina Faso, Côte d'Ivoire, Ghana, Mali, Niger, Nigeria, Senegal, Togo and other countries in the region, to address diagnostic needs (Fig. 2). These

FIG. 2. The Agency contributed to strengthening capacities for early and rapid diagnosis of avian influenza in animal populations in 2015.

missions proved to be very successful in the rapid diagnosis of the disease. As part of the emergency response, the Agency, in collaboration with FAO, provided diagnostic toolkits, validated guidance and standard operating procedures, and supplied on-line support for the expert missions.

Food Safety and Control

"Fifteen irradiation treatment methods included in International Plant Protection Convention standards were developed in joint FAO/IAEA coordinated research projects."

To promote food safety, the Agency continued to facilitate laboratory networks to enable Member States to share technical expertise, supply chain information, experience and resources. The initial focus of network building was in the Latin America and the Caribbean region, and in 2015 this successful initiative was extended to both Africa and Asia.

In 2015, the Agency held 36 training courses and workshops related to food safety, quality, authenticity and traceability. It also hosted, developed and maintained the Food Contaminant and Residue Information System (FCRIS). This free on-line resource provides information on different methods of analysis and on food contaminants and residues, including chemical and toxicological data on pesticides and veterinary drugs. At the end of the year, 110 veterinary drug or pesticide residue analysis methods were available on FCRIS, an increase of over 20% compared with 2014.

Standards and guidelines developed by the Agency in collaboration with Member States and other international organizations provide the framework for promoting trade in irradiated foods. Fifteen irradiation treatment methods included in International Plant Protection Convention standards were developed in joint FAO/IAEA coordinated research projects. The Agency also published a new *Manual of Good Practice in Food Irradiation: Sanitary, Phytosanitary and Other Applications* (Technical Reports Series No. 481) to support the uptake and implementation of the technology. The increasing commercial use of irradiation as a phytosanitary treatment is helping producers overcome insect pest related trade restrictions and reach markets that would otherwise be closed to them.

Mutation Breeding for Crop Improvement

Climate influences both the yield and the quality of crop plants. The negative effects of climate variability and conditions such as floods, drought, heat and salinity are major constraints affecting sustainable agricultural productivity around the world. Mutation breeding techniques and related biotechnologies are important tools for meeting this challenge. Mutation breeding has been used successfully to improve crops for over 70 years, with 3233 mutant varieties released during that time.

With Agency support, in 2015 Mongolia released a new wheat mutant variety — Darkhan-141 — for use as both food and animal feed. Darkhan-141 is resistant to lodging (bending of the stem) and drought, and has higher productivity than other varieties suitable for production under the country's climatic conditions.

Through national and regional technical cooperation projects, the Agency supported Malaysia in developing two rice mutants with high yield under minimal water conditions. These drought tolerant mutants have great potential for use in a broad range of the rice growing areas in Malaysia. The mutant lines were registered in 2015, and one is expected to be officially released in 2016. A technology package provided to farmers including the mutant variety and a biofertilizer doubled the yield of rice on two experimental sites.

In 2015, the Agency launched a new CRP entitled 'Efficient Screening Techniques to Identify Mutants with Disease Resistance for Coffee and Banana', to combat pathogens that attack these important crops. As part of the CRP, mutation techniques will be used to develop new varieties with resistance to these biotic stresses.

The Agency completed a technical cooperation project entitled 'Assessing Crop Mutant Varieties in Saline and Drought Prone Areas Using Nuclear Techniques' in 2015. Through technology transfer and capacity building, the Agency helped Bangladesh to develop a total of 13 mutant varieties of rice through the application of mutation breeding techniques. The development of a number of high yield crop varieties helped farmers in the country to adapt to changing climatic conditions, thus mitigating the effects of failed or low yield harvests. The project successfully addressed both drought and saline soil conditions — two environmental challenges affecting crop yield that require different crop mutations for ideal climatic adaptation. The increased food and economic security resulting from these crop varieties are already having a positive effect on the livelihoods of farmers in the country.

"The development of a number of high yield crop varieties helped farmers… to adapt to changing climatic conditions."

Land and Water Management

Land degradation costs US $10.6 trillion around the world each year, and soil erosion is the main contributor. About 75 billion tonnes of fertile soil is lost each year through soil erosion. This loss of land increases sedimentation in streams and rivers, and can lead to flooding. Sustainable land use can help to reduce the impacts on agriculture and livestock, and can prevent soil degradation and erosion, and the loss of valuable land.

Fallout radionuclides are robust, cost effective tools for tracing and quantifying soil redistribution and sources of erosion within agricultural landscapes, so that soil conservation practices can be implemented to minimize this loss. Through two technical cooperation projects, the Agency assisted Member States in Africa and in the Asia and the Pacific region in using this technique to address soil erosion. In 2015, the Agency used nuclear techniques to identify the sources of soil erosion, and to quantify soil erosion rates, for 27 study sites in a 10 000 km² area of Lam Dong Province in the southern part of the central highlands of Viet Nam. The study showed that soil losses from erosion could be reduced by 47% through intercropping on coffee or tea tree plantations; using vetiver grass hedgerows and green manure management; creating water catchment basins at the base of coffee trees; and using contour and terraced farming. If applied to the total area of land affected by soil erosion in Viet Nam, these practices would result in a reduction of fertilizer use totalling US $74 million.

In 2015, the Agency joined the global community in celebrating the International Year of Soils by hosting a major event to commemorate World Soil Day in December. Also that month, an article on the Agency's work in this area was published in *National Geographic*, highlighting how nuclear techniques can help in assessing and curtailing the worldwide threat of soil erosion.