

Food and Agriculture

Objective

To enhance capabilities within Member States for alleviating constraints to sustainable food security by application of nuclear techniques.

Sustainable Intensification of Crop Production Systems

Up to 80% of a plant's yield can be lost because of drought and salinity. This problem is particularly severe in developing countries — especially in arid and semi-arid regions — resulting in damage to the livelihoods of people in the short term, and in long term effects on food security. The Agency has helped introduce plant breeding and selection methods that can lead to new, better adapted varieties of basic food and industrial crops, which are also higher yielding. Its activities have focused primarily on Asia, but also on Africa and Latin America.

Eight new high quality rice mutant varieties have been produced and adopted by farmers in Vietnam, where rice export is a major source of revenue. One new mutant rice variety, registered as a national variety with a quality suitable for export, is of short growth duration (100 days), meaning that three rice harvests a year are possible in the Mekong Delta (Fig. 1). Another mutant rice variety with high quality and tolerance to salinity became the key rice variety for export in 2005, occupying 28% of the one million hectare export rice growing area in the Mekong Delta. In addition, salt tolerant rice mutants were developed through gamma irradiation at the Agency's Laboratories, Seibersdorf. Four mutants developed by the Agency were introduced into nine breeding programmes by the International Rice Research Institute, in the Philippines. The salt tolerant rice cultivar target area for Bangladesh, India, the Philippines and Vietnam is estimated at 4.3 million hectares.

Use of a new mutant variety of wheat that is tolerant to drought — produced through the application of nuclear and in vitro techniques — is expanding in Kenya. It has led to an improvement in the quality and quantity of harvests and to enhanced incomes for local farmers. The demand for the new variety is rising sharply because of the rapid increase in population, preference for wheat products and

growing urbanization. Following the success of this project, mutation induction is now being actively promoted in Kenya for the improvement of other staple and cash crops.

In the northern provinces of Zambia, the Agency has developed two high yielding finger millet varieties, which in pre-release trials showed between two and three times higher yield than local traditional varieties. The improved mutant varieties have been tested in areas where people are heavily affected by HIV/AIDS. The intention is to improve local cash earnings, as well as the health and nutrition condition of the residents.

Results of research from a CRP on sustainable crop production in agroforestry systems have shown that trees, when grown with crops, significantly enhance their productivity, plant nutritional quality and livestock nutrition. Such agroforestry systems can improve the physical properties of the soil and plant nutrient uptake, while reducing nutrient, topsoil and water losses in deep drainage. Evidence from China and Malaysia indicates that once agroforestry systems have become established, water is made available from deeper soil layers and thus improves water availability for the associated crops.

Approximately 64% of potentially arable land worldwide is composed of acid soils, 1700 million hectares being located in the humid tropics. As part of a CRP, the Agency assisted 11 countries in Latin America and Africa in the use of nuclear and related techniques to identify acid-tolerant and phosphorus efficient genotypes and develop optimum management practices for correcting soil acidity constraints. The CRP's findings also resulted in the



FIG.1. Harvesting of a high yield rice variety in Vietnam.

drafting of a publication on the Use of Phosphate Rocks for Sustainable Agriculture.

Using SIT to Improve Health and Improve Food Production

To facilitate fruit and vegetable exports from Central America and Panama, an area-wide integrated fruit fly pest management approach that includes the sterile insect technique (SIT) was started in 2001. Four international organizations, two donor government institutions from Mexico and the USA and the ministries of agriculture of Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama, joined the effort under the umbrella of a regional technical cooperation project. The five year project has culminated in a number of officially recognized areas in each of the participating countries that became either free of fruit flies or had low prevalence of these insects. As a result, fresh fruits and vegetables can now be exported from these areas, resulting in a very significant economic and social impact on the region. In addition, Member States have developed the regulatory, human and physical infrastructure to be able to sustain the status of these areas.

A major success in 2005 was the complete eradication of fruit flies from the Patagonia region of Argentina. This very positive development represents the culmination of ten years of technical support provided by the Agency and FAO in efforts to implement SIT as part of an area-wide integrated pest management approach. Crucially, this achievement — which was officially recognized by the USA — will allow Patagonia to export fresh fruits and vegetables to the USA without any quarantine treatments, representing annual savings of millions of dollars. It also opens the possibility of exporting other fresh fruit crops. It follows the establishment of similar pest free zones, with Agency support, in Argentina's Mendoza Province. The Ministry of Agriculture has now agreed to fund a new fruit fly management programme over an area of 56 000 hectares comprising the main citrus producing provinces of Entre Ríos and Corrientes in northeastern Argentina.

To assist tsetse SIT projects in Africa, the Agency provided support for the establishment of a tsetse rearing facility at the Institute of Zoology of the Slovak Academy of Sciences. The facility is expected to provide seed tsetse colonies to large facilities in Africa such as the one being constructed in Ethiopia



FIG. 2. A tsetse mass rearing facility under construction in Ethiopia.

(Fig. 2). This transfer will accelerate the development of large mass reared colonies needed for field releases. Three different tsetse species are currently being reared and the completed facility now maintains a colony of about 120 000 female tsetse. It is planned that shipments to Africa will begin in the middle of 2006.

The first comprehensive textbook on SIT — Sterile Insect Technique: Principles and Practice in Area-Wide Integrated Pest Management — was published in 2005. Compiled by the Agency and FAO, with contributions by 50 authors worldwide, the textbook is being provided to many counterparts and institutions in Member States to help them understand the potential of SIT.

An ongoing project was expanded in 2005 to assess the feasibility of using SIT to control malaria transmitting mosquitoes. The species targeted in the project is *Anopheles arabiensis*, the second most important malaria carrier in Africa. Research is aimed at identifying a radiation strategy that will lead to sterility in male mosquitoes without compromising their mating performance in the field.

Sustainable Intensification of Livestock Production Systems

Artificial insemination (AI), used as a biotechnology for livestock production, can decrease disease transmission, increase the rate of genetic improvement, and provide a significant cost advantage compared with traditional breeding methods. Nuclear techniques such as radioimmunoassay (for example to measure hormones) can identify and mitigate constraints to efficient livestock production, improve the delivery of national AI services and provide diagnostic

services to farmers. The Agency work in 2005 focused on improving the management of AI, mainly by coordinating the work of laboratories in Africa and Asia and their local farmers, veterinarians and AI technicians. One result has been that milk production from yaks in northwest China, for example, has significantly increased. In addition, improved monitoring of the reproductive cycle and application of approved practices for AI have significantly increased conception rates.

Nuclear and related methodologies for the measurement of tannins and strategies for enhancing the utilization of tannin-containing feed resources, such as tree leaves and agroindustrial by-products, were transferred to nine Member States, and further disseminated through a special issue of the journal *Animal Feed Science and Technology*. In addition, strategies for decreasing the emission of methane (a greenhouse gas) and enhancing livestock productivity are being evaluated in 15 Member States. In order to strengthen this programme, a training workshop on the 'Determination of Methane Emission from Ruminants' was conducted for teams from eight Member States. These efforts have enabled the development of novel, efficient and environmentally friendly feeding strategies using locally available feed resources. The results developed from a CRP and from Agency technical cooperation projects have substantially increased the income of farmers. In one case, nitrogen-15 based characterization of tree leaves and aquatic plants as suitable feed for pigs decreased the cost of raising pigs by 15%, resulting in an additional profit of \$19 per pig for farmers.

Reagents for detecting antibodies against the non-structural proteins of the foot and mouth disease virus – to permit the discrimination of vaccinated and field infected cases – were further validated. The process for the import and irradiation of sera

by the Agency's Laboratories, Seibersdorf, to act as foot and mouth disease reference standards, was finalized; sera were received for three different serotypes of the virus from two Member States.

Quality assured procedures and implementation guidelines were developed for enhancing the proficiency of veterinary diagnostic laboratories and introduced to 30 Member States through an interregional project. In addition, several publications on improving the technical understanding in Member States of nuclear and nuclear related methods and their applications to animal production were produced, including books on the polymerase chain reaction and gene based technologies.

Improving Food Quality and Standards

In its activities related to a comprehensive approach to food production systems, the Agency assisted Member States in strengthening compliance with food and environmental safety standards through good agricultural practices. This assistance included a training workshop on quality assurance/quality control measures in pesticide residue analytical laboratories at the Joint FAO/IAEA Agriculture and Biotechnology Laboratory in Seibersdorf.

Agency work on the application of irradiation for sanitary and phytosanitary purposes included the completion of a project on the effectiveness of irradiation to ensure hygienic quality of fresh, pre-cut fruits and vegetables and minimally processed food of plant origin. This resulted in the analysis of more than 30 types of vegetables and sprouts and eight types of fruits for the evaluation of the effectiveness of irradiation in ensuring the microbiological safety of foods related to 12 pathogenic bacteria. ■