ON-GOING RESEARCH PROJECTS AT ANKARA NUCLEAR RESEARCH CENTER IN AGRICULTURE AND ANIMAL SCIENCE

Tükenmez I.
Nuclear Research Centere, Ankara, Turkey

ABSTRACT

The projects in progress conducted by the Center comprise nuclear-aided researches in soil fertility, plant nutrition, plant protection, improvement of field crops, improvement of horticultural plants and forest trees by mutation breeding, *in vitro* culture technique with mutagen treatments, use of phosphogypsium in soil amelioration, sterilazation of medical supplies, wastewater treatment, animal nutrition, animal health and productivity and accreditation. The on-going main projects involving several sub-projects with the above subjects were summarized for possible future collaborations.

INTRODUCTION

The research and development activities of Ankara Nuclear Research Center in Agriculture and Animal Science (ANRCAAS) are concentrated on the contribution of atomic energy to peace by the use of nuclear and related techniques in food, agriculture and animal science. Nuclear techniques are used in the above fields in two ways: *in vitro* or *in vivo* radiotracing the substances and processes of biological importance, and irradiation of biological materials for preservation and quality modification. Research projects are carried out by interdisciplinary studies with well equipped laboratories at the Center in close cooperation with other institutions. The projects are supported by national and international funding organizations including Turkish Atomic Energy Authority (TAEA), State Planing Organization (SPO), Science and Technical Research Council of Turkey (STRCT), and Joint FAO/IAEA Division through Technical Co-operation Projects (TCP) and Co-ordinated Research Projects (CRP). The projects in progress conducted by the Center comprise nuclear-aided researches in soil fertility, plant nutrition, plant protection, improvement of field crops, improvement of horticultural plants and forest trees by mutation breeding, *in vitro* culture technique with mutagen treatments, use of phosphogypsium in soil amelioration, food irradiation, sterilazation of medical supplies, waste-water treatment, animal nutrition, animal health and productivity and accreditation. The results of these projects either have academic value or can be transitioned into industrial applications. The on-going projects with the above subjects will be summarized for possible future collaborations. The following are the main projects which involve several sub-projects. Each summary contains the name of project leader(s) and appropriate e-mail address for further information.

Nuclear and Modern Techniques Used in Soil Fertility and Plant Nutrition (*AP2.B.1)*

Project Coordinator and Principal Investigator: M. Basri Halitligil, Zafer Sağel; basri@taek.gov.tr, zafer.sagel@taek.gov.tr

Objectives of the project are:

- To determine the optimum rates of nitrogen which will increase the plant yields and their quality,
- To determine the water and fertilizer use efficiencies of plants under different irrigation and fertilization systems which will end up in water and fertilizer savings,
- To decrease or prevent the nitrate contaminations of plants, soils and ground waters which can be hazardous to animal and human health,
- To attain the large scale farmer applications of the research findings,
- To train the researchers in nuclear techniques at other institutes .

The Use of Nuclear Techniques in Plant Protection (AP2.B2)

Project Coordinator and Principal Investigators: M. Basri Halitligil, Osman Tiryaki, Zafer Sağel; *basri@taek.gov.tr, Osman.tiryaki@taek.gov.tr, zafer.sagel@taek.gov.tr*

Objectives of the Project:

- To obtain more quick and reliable result by using nuclear techniques in the biological, physiological and toxicological study which is carried out to determine effect of insecticides on arthropods .
- To set database related to control of stored pest by using gamma irradiation and to use of nuclear techniques in biological control.
- To get resistant plant varieties against the plant diseases by using gamma irradiation.
- To inhibit mycotoxin production with gamma irradiation.
- To increase laboratory performance in pesticide residue analysis with validated analytical methods.
- To get more reliable analytical residue data by working according to quality assurance / quality control (QA/QC) and good laboratory practice (GLP) system and by using radyoisotope-tracer techniques.

Improvement of Yield, Quality, Adaptation and Resistance to Biotic and Abiotic Stress Conditions of Field Crops by Nuclear Techniques (A.P.2.B.3)

Project Coordinator and Principal Investigators: Zafer Sağel, Hayrettin Peşkircioğlu, M.Basri Halitligil; *zafer.sagel@taek.gov.tr, hayrettin.peskircioglu@taek.gov.tr, basri@taek.gov.tr*

Other Counterpart Institutions: Niğde Potato Research Institute, Department of Agronomy of Agricultural Faculty-Ankara University

Objectives of the Project:

To determine the effect of different types and doses of irradiation on field crops grown in Turkey (cereals, food legumes, industrial and fodder crops). Under this main project, basic radiobiological research and determination of radiation dose rates for mutation breeding of main variety and species have been conducted. As a result of these basic data, plant breeding projects have been initiated for developing mutant cultivars for different environment conditions and

demand of market and consumers. On the other hand, the methods and knowledges gained after these extensive work have been transferred by publications, training courses, and symposiums.

Improvement of Agricultural Qualifications of Horticultural Plants and Forest Trees by Mutation Breeding Techniques (A.P.2.B.4)

Project Coordinator and Principal Investigators : Zafer Sağel, Hayrettin Peşkircioğlu, Burak Kunter, Yaprak Taner; *zafer.sagel@taek.gov.tr, hayrettin.peskircioglu@taek.gov.tr, burak.kunter@taek.gov.tr, yaprakt@taek.gov.tr*

Other Counterpart Institutions: Ministry of Agriculture and Rural Affairs / Citrus Research Inst., Atatürk Horticultural Central Research Inst., Dpt. of Horticulture of Agricultural Faculty-Ankara Univ., Dpt. of Horticulture of Agricultural Faculty-Çukurova Univ., Dpt. of Chest Trouble and Allergy of Faculty of Medicine – Ankara Univ., Central Anatolia Forestry Research Institute of Ministry of Environment and Forestry.

Objectives of the Project:

One of the main groups of plant oriented foods in human diet is horticultural crops (fruits, vegetables and grapes) and decoration plants and rare forest trees. These species has many problems that have been solved only by nuclear tecniques. Overall these problems, with our species and varieties, basic radiobiological researches and efficient radiation dose determination researches have been initiated. After our extensive research work we aim to transfer our knowledges by publications, periodically arranged training courses, and by presentation at symposiums.

Determination of Culture Media Types and Culture Conditions, Imporevement of Resistance to Biotic and Abiotic Stress Conditions under Laboratory Conditions and Propagation Culture Plants by *in vitro* Techniques in Turkey (A.P.2.B.5)

Project Coordinator and Principal Investigators: Zafer Sağel, Hayrettin Peşkircioğlu, İhsan Tutluer; *zafer.sagel@taek.gov.tr, hayrettin.peskircioglu@taek.gov.tr,ihsan.tutluer@taek.gov.tr*

Other Counterpart Institution: Dpts. of Horticulture and Plant Protection of Agricultural Fac.- Ankara Univ.,

Objectives of the project:

- Determinations of *in vitro* propagation methods of field crops and horticultural crops grown in Turkey.
- Propagation and test of mutants that are handled by *in vitro* and *in vivo* physical and chemical mutagens.

Handling of pure line plant species by doubled haploidy, embrio rescue and somatic embryogenesis.

- Application of some parts of field researches under laboratory conditions as stress tolerance researches.
- Improvement of new cultivars in short time for farmers.

Radiotoxicological Investigations of Phosphogypsium (a by-product of fertilizer industry) in Ameloriation of Salt Affected Soils (AP2.B.8)

Project Coordinator and Counterparts: M. Basri Halitliğil (General Coordinator), İbrahim Tükenmez, Haluk Yücel, Bülent Sönmez; *basri@taek.gov.tr, ibrahim.tukenmez@taek.gov.tr*

Other Counterpart Institutions: Ankara Nuclear Research and Training Center, Fertilization Researc Inst.

Objectives of the project are:

- to determine the additional radioactivity which may come from the radionuclides such as Ra-226, K-40 and U-238 when phosphogypsium is applied to soils; and also to find out if this additional radioactivity would be a risk for human health,
- to determine the risk of heavy metal (such as Cd, Pb and Hg) contamination of plants when phosphogypsium is used ,
- to determine the transfer of radioactivity from soil to plants when phosphogypsium is applied to soils as an ameloriant for the improvement of sodium and salt affected soils,
- to determine the health effects of plants (which are grown after phosphogypsium application to soils) for human and animal consumption.

Use of Nuclear Techniques in Animal Nutrition (AP2.B.6)

Project Coordinator: Faruk Ildız; *faruki@taek.gov.tr*

Other Counterpart Institutions: Faculty of Agriculture and Veterinary Medecine of Ankara Univ., Kırıkkale Univ., Fac. of Veterinary Medecine, Ministry of Agricultural and Rural Affairs, Ministry of Health.

Objective of project: To improve animal productivity and feed utilization by the use of nuclear and related biotechnological techniques in animal nutrition researches. The Project involves: Evaluating feedstuffs for animals in terms of chemical composition and nutritive value; evaluating animal response to different diets and nutritional factors in terms of changes in intake, digestion, metabolism, utilization of feed, body weight, body condition, quality/quantity of products, and interaction with other environmental factors; diagnosis of nutritional disorders; preparation, treatment, mixing and conservation of feedstuffs; formulating ration, complete supplement, vitamin and mineral premixes and feed additives; rumen fermentation, digestion and absorption of nutritients, and manipulation of these processes; effects of nutrition on reproductivity and fertility; environmental aspects of animal nutrition; nuclear and related technologies for animal nutrition studies; mechanistic study and mathematical modelling of nutritional processes.

Support: UAEA CRP TUR-11891, SPO/ DPT 98K 120230

Use of Nuclear and Biotechnological Techniques in Animal Health and Production (AP2.B.7)

Project Coordinator: Zisan Emre; *zisan.emre@taek.gov.tr*

Other Counterpart Institutions: Ankara Univ., Faculty of Veterinary Medicine, Kırıkkale Univ., Faculty of Sciences, Ankara Central Wastewater Treatment Plant.

Objectives of the Project:

Through the use of nuclear and related and biotechnological techniques helping to solve the problems on improvement of animal health, breeding, production, and reproductive performance, hence, increasing food quality and security for the wellbeing of human population and the economy in connection with the related sectoral institutions for the immense benefit of Turkey. The project scope:

- Improvement of animal health, reproductive performance, productivity, and wellfare by using isotopic and related techniques and biotechnology through researches and technology transfer,
- Development of disease diagnosis through refined biochemical and immunological methods to produce the reagents which form the components of the specific and sensitive diagnostic kits.
- Detections and identifications of pathogens by using genetic materials to provide rapid, reliable and accurate diagnosis of the infectious and parasitic diseases.
- Facilitate high productivity, well adaptation and disease resistancy in native breeds by using genetic materials coding productivity measures.
- Improvement of animal health by eliminating the disease causing potential of some parasites and vectors by using ionasing radiation to produce vaccines through the attenuation or tissue-culture techniques,
- Increasing the productivity in local breeds through the development of feeding and supplemention strategies to reduce methane production,.
- Improvement of efficiency of livestock production and health for food quality and security for the wellbeing of the people and the economy.
- Dissemination of the outcomes of the studies by means of courses, seminars and publications.

Funds of the Project : IAEA/CRP-12673, IAEA/RER/5/012, SPO/ DPT 98K 120230, STRCT/ VHAG-2100

Implementation of Food Irradiation Technology in Turkey (AP.2.E.1)

Project Coodinator: Nurcan Çetinkaya; *nurcet@taek.gov.tr*

Other Counterpart Institutions: Ankara Univ.-Faculty of Eng.- Dpt. of Food Eng, Hacettepe Univ.-Fac. of Eng.-Dpt. of Food Eng., Ministry of Agriculture and Rural Affairs, General Directorate of Protection and Control, Ministry of Health, General Directorate of Primary Health Services, Secretary General of Aegean Exporters' Union, Gamma-Pak, TARİŞ, Malatya Apricot Foundation, Erüst Tarım , Antalya Exporters' Union.

Objectives:

- Implementation of food irradiation technology in Turkey.
- Research studies which need at the implementation stages
- Studies on integration of food irradiation technology to HACCP system
- Establishing of central reference laboratory for detection of irradiated foods

Targets:

- Establishing of a food irradiation facility in Aegean Region (Izmir)
- Transfering the available information such as regulations, standards, agreements ,trade of irradiated foods and irradiation technology to producers and exporters for dried fruits and nuts
- Acceptance of food irradiation technology as an effective method for disinfestation of dried fruits and nuts and pulses by food industry
- Increasing of food hygiene levels by using food irradiation technology
- Increasing of food quality and extention of self life
- Detectability of irradiated foods in Turkey
- Ensuring the consumers acceptance of irradiated foods in respect to food safety
- Harmonization of related regulations about food irradiation in Turkey and adaptation of international standards and agreements.
- Inspection and certification of private sector food irradiation facility and endorsement of private sector food irradiation facility by EU
- Solving the quarantine problems of cut-flower exporters and also improving their trade by extention of vase-life of flowers.
- Publishing the obtained results at national and international journals.

Support: IAEA-TUR 5/0/22, IAEA-CRP-11650, SPO/ DPT 98K 120230

Radiation Sterilization of the Single Use Medical Supplies (*AP2.E.2)*

Project Coordinator and Principal Investigators: Galip Siyakuş, Talat Aydın; *galips@taek.gov.tr, talat.aydin@taek.gov.tr*

Objectives: The aim of the project is to document the agreeableness acceptable of international standards through irradiation and sterilization of the single use medical supplies, to increase the irradiation capacity and the native input rate of this technology.

Targets:

- To document the international traceably of High Dose Dosimetry Laboratory, Gamma Irradiation Facility and Dose measurements of industrial and experimental irradiation sources as accurate and determine uncertainty levels, establish and realize experimental irradiation dose measurements.
- To certificate of dose setting and sterility test in international acceptability performed at Radiation Microbiology Laboratory, to serve the industry and to adapt the Laboratory procedures to national regulations.

- Use of routine radiation dose measurements at Gamma Irradiation Facility of prepared alanine dosimeters, as standard and reference dosimeter at High Dose Dosimetry Laboratory. Thus, increase of the national technological product rates at irradiation process.
- Calibration of the routine dosimeters.
- Determination of the Dmax/Dmin ratio in the foodstuffs and medical suppliers, irradiated at the Gamma Irradiation Facilities by the alanine dosimeters.
- Decrease of external dependence on supply of the routine dosimeter.
- A dosimeter laboratory that will give service to provide sector a laboratory-scale irradiation sources will be provided by the Gamma Irradiation Facility of the Department.
- It will be possible to apply one next Europe Union Standards as directed at irradiated foods detection with the EPR equipment.
- To form knowledge and data background for the subject of effect of the irradiation and the change of properties after irradiation of the polymers produced in Turkey. To search the compatibility of domestic polymer to be used in the medical supplies.
- Research for compatibility of domestic polymers for dosimetry studies and dose measurement studies by use of Chemiluminencence Analyzer.
- The generalization that sterilization method of radiation will be increased technical knowledge and provide to support through single use medical producers.
- Research studies for the parameters of the production of highly biocompatible and having better surface properties biopolymer by means of irradiation.
- The industrial irradiation income will increase above 180 billion TL at 2003, 2 times at 2005, 3 times at 2006, whenever increasing irradiation power of the Gamma Irradiation Facility. The contribution to the country economy will become more than planned amount.
- Improving the conditions and facilities for material compatibility tests, dose measurement and dose setting studies in accordance with the latest standards approved by developed countries. Also, certification of those testing and measurement abilities to provide more prestigious, reliable and high quality service in this field to the private export companies.

Supports: State Planning Organization

Radiation Processing Technology for Industrial Wastewater Treatment (AP.2.E.3)

Project Coordinator and Counterparts: Ömer Kantoğlu, Dilek Şolpan Özbay (counterpart), Hüseyin Şen (counterpart) , Fevzi İşbilir (counterpart); *omer@taek.gov.tr*

Other Counterpart Institutions: Univ. of Hacettepe- Faculty of Science, Dpt. of Chemistry, Ankara Nuclear Research and Training Center, Turkish Grain Board-Bolvadin Opium Alkoloid Plant, Ministry of Forestry and Environment-General Directorate of Environmental Managment.

Objectives: The aim of the project is to promote the radiation processing technology in the treatment of industrial wastewater by using gamma rays and/or electron beam and also to widespread the technology in this field. Development of the laboartory infrastructure and training of the laboratory staffs, who will carry out the proposed activities and will transfer this modern technology are also under the project goals due to the achievement of the project outputs.

Targets:

- Obtaining of experimental data by using radiation processing technology in the treatment of waste of Bolvadin Opium Alkoloid Plant, which has not been solved by conventional technologies.
- Designing and feasibility study of wastewater treatment unit for the treatment of opium manufacturing plant effluents by using the obtained experimental results in order to apply and promote the radiation processing technology.
- Establishment of a basic knowledge and experience on the treatment method of radiation processing to be applied the other fields such as textile and paint industry
- Project final report and publishing of scientific article(s).

Support: IAEA-TUR/08/017-Radiation Processing Technology for Industrial Wastewater Treatment, State Planning Organization.

Accrediation Project of ANRCAAS (AP.5.C.2)

Project Coordinator and Principal Investigators: İbrahim Tükenmez, Ahmet Demirel, Zafer Sağel; *ibrahim.tukenmez@taek.gov.tr, zafer.sagel@taek.gov.tr*

Objectives of the Project:

- To accredit ANTHAM laboratories according to TS-EN ISO17025 standards.
- To get valid of laboratory national and international levels