ACHIEVEMENTS OBTAINED IN AGRICULTURAL RESEARCH BY USING NUCLEAR TECHNIQUES IN TURKEY

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Ankara Nuclear Research Center in Agriculture and Animal Sciences (ANRCAAS) is one of the four unique research centers belonging to Turkish Atomic Energy Authority. ANRCAAS is unique because it is the only center in Turkey which uses nuclear techniques as a tool to solve problems for agriculture or animal sciences which cannot be solved using conventional techniques. Training and Research in the areas of agriculture, animal science, food preservation and sterilization via nuclear techniques are among the objectives of the Center. In this paper, the research activities carried out and the achievements so far obtained in the agricultural specialties of Plant Breeding, Soil Fertility and Plant Nutrition, Plant Protection and Pesticide Residues –all by using nuclear techniques– will be given.

Plant breeding research at the Center is mainly based on mutational breeding of cereals, food legumes and fodder crops. Genetic variation is the basis of all plant breeding and is used to develop cultivars of improved in yield and quality, resistant or tolerant to diseases, higher nitrogen fixation capacity and sustainable for mechanized harvesting. When desired variants are not available, radiation and chemical mutagens have been applied to induce genetic mutations from which the desired mutants may be selected. In addition, in vitro culture techniques, in combination with mutagen treatments, have recently been applied to increase the probability of selected mutants, promote the breeding of better crop cultivars and shorten the breeding period and time required.

Aiming at the above-mentioned purposes, a project had been started in 1982 on soybean mutation breeding. This project has been completed successfully. Two mutant soybean varieties were registered in 1994 and named TAEK-A3 and TAEK-C10. The new varieties exhibited higher seed and oil yields per unit area, higher first pod height and protein content than the control. In 1984, a tobacco mutation breeding program was initiated in collaboration with the Ministry of Agriculture, with the aim of improving a well-adapted cultivar that was susceptible to blue mold. The method used upon successful completion of the project, was the induction and selection of resistant mutant with desirable agronomic and quality traits, two mutant Tobacco varieties were registered and named as TAEK-TUTLUER and TAEK-PESKIRCIOGLU in 1999 both resistant to blue-mold.

Other investigations involving mutation are continuing such as in the determination of a suitable irradiation dose for different crops, obtaining and improve a semi- draft barley for beer making, and to obtain new varieties of wheat, chickpea, soybean, flax and rye mutant varieties. Recently, cytological work on soybean, rye, cotton and barley have been started to determine chromosomal abnormalities and obtain different morphological types in *Salx babylonica*.

Tissue-culture studies are also proceeding at the Center to explore shortening the time in mutation breeding and overcoming the genetic and biological problems that are encountered during mutational work using anther-culture (barley, wheat, rapeseed), immature-embrio (wheat), double-haploid (wheat, melon, cucumber and garlic).

The main aim of the Soil Fertility and Plant Nutrition research work is to improve and increase the plant yields and quality via increasing the soil fertility levels. In order to do this radioactive

and stable isotopes are used for determining the fertility levels of the soils, the fertilizer use efficiencies of plants, the relationships of fertilizers in different environments, and the transformations and movements of fertilizers in the soils. Also, ^{15}N and neutron probe techniques are being used to determine the soil-plant-water relationships, especially for optimization of nitrogen and water. In this respect, availability of the macro and micro plant nutrient in Turkish soils, fertilizer and water requirements of crops (such as wheat, corn, sugar beet, soybean, tomato, pepper, cucumber) for higher yields are being investigated using nuclear techniques such as labeled fertilizers and neutron probes. Also, N-fixation capacities of legumes are determined using ^{15}N labeled fertilizers. The ultimate goal of the Soil Fertility and Plant Nutrition investigations is to use the soil and water resources of Turkey efficiently in obtaining higher crop yields while increasing the quality.

Recently, drip irrigation-fertigation studies on potato in the Niğde-Nevşehir region using ^{15}N and neutron probe techniques showed that by using 50% less irrigation water in comparison to sprinkler irrigation systems, the same amount of marketable tuber yields – 4 tons/da can be obtained. There are 30 000 decares of potato field in Niğde-Nevşehir region of Turkey. Farmers began to use this new drip irrigation-fertigation system which will bring them much economic benefit. Drip irrigation-fertigation studies on tomato, cucumber, pepper and melon crops are being investigated to improve their yields and qualities.

The aim of plant protection research work is to protect agricultural products against insects, plant diseases and weeds. In this field, control of post harvest diseases is possible by using gamma irradiation.

Combination of irradiation with refrigeration, hot water and chemical treatment has more effect against the fungal agent. Gamma irradiation can be used as an effective method for insect disinfestation in the stored products.

Another research subject is to determine pesticide (which is used to control insects, plant diseases and weeds in the agricultural products) residues in plants and soil. It is possible to determine the total and bound residues quantitatively, and extractable residues both quantitatively and by using a radiotracer technique in combination with other chromatographic techniques such as TLC, GC, and HPLC. Nowadays there is a special interest in identifying the nature of the bound residues that cannot be extracted by conventional extraction techniques.

Supercritical Fluid Extraction (SFE) techniques may provide possible means for extraction and identification of bound residues in the plant and soil samples. Pesticides for registration should be properly assessed for bound residue formations. Pesticides now in use, that have not already been assessed for bound residues formation and their potential toxicity, should also be investigated.

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