

II. AGRICULTURAL RESEARCH INSTITUTE

1. INTRODUCTION

The Agricultural Research Institute (ARI) undertakes research within the wider domain of plant and animal production. It comprises the Research Sections of Fruit Trees and Viticulture, Plant Improvement, Vegetable and Ornamental Crops, Plant Protection, Soil Science, Animal Production, Agricultural Development and Agrobiotechnology, as well as the autonomous units of the Variety Examination Center and the Farm Accountancy Data Network. The Institute is equipped with state-of-the-art laboratories pursuing analytical work in a range of fields encompassing molecular biology, agricultural chemistry, postharvest technology, phytopathology, entomology/toxicology and tissue culture. The ARI infrastructure also includes an extensive library and modern greenhouse and cold storage facilities. The National Gene Bank and the National Herbarium are stationed at the ARI. An experimental livestock (cattle, sheep and goats) farm operates at Athalassa and outstations exist at Akheleia and Zygi for citrus, flowers, vegetables and field crops, at Saittas for deciduous fruits and vines and at Xylotympou and Polis for citrus, vegetables and cereal breeding. Extensive experimentation is also undertaken in cooperation with farmers on private agricultural land.

The Variety Examination Center was established by the Institute, in accordance to the provisions of the new Law on seeds aligned with EU regulations. The ARI is the National Focal Point for Food and Agriculture Organization (FAO) projects related to conservation and utilization of plant and animal Genetic Resources in agriculture.

Results of ARI's research are published in international peer-reviewed journals or in its own publication series in English and Greek.

The Institute is the national AGRIS Centre collecting, cataloguing and indexing the agricultural literature published in Cyprus, and is also the national CARIS Centre collating information on ongoing research. The Institute cooperates with international and regional organizations, such as the FAO, the International Atomic Energy Agency (IAEA), the International Center for Agricultural Research in the Dry Areas (ICARDA), the International Plant Genetic Resources Institute (IPGRI) etc., and with national research organizations and institutions of the European Union.

2. FRUIT TREES AND VITICULTURE

The Section's research work comprises the study for improvement of yield and quality of fruit trees and vines. Work in viticulture included the evaluation of new table grape varieties at two locations. The table grape varieties Superior, Crimson Seedless, Black Emerald, Fantasy Seedless, Veriko and Sideritis and the local winegrape variety Maratheftiko are evaluated on five American rootstocks resistant to phylloxera. Local wine grape varieties are

evaluated and data for the ampelographic description of the varieties is collected at Saittas Experimental Station.

At Saittas Experimental Station, several cherry varieties are also evaluated in terms of fruit quality, yield and time of ripening. Clones of pomegranate are studied regarding their morphological characteristics and phenological stages and evaluated in terms of yield and quality.

Imported varieties of citrus are tested, and rootstocks tolerant to tristeza virus and calcareous soil conditions are evaluated in order to replace the commercial sour orange rootstock susceptible to the disease.

3. PLANT IMPROVEMENT

The main activities of the Plant Improvement Section concern the improvement through breeding of barley, forage plants (cereals and legumes), pulses, durum and bread wheat, Triticale as well as the study of the genetic and environmental factors affecting their yield, quality and resistance to diseases. Also, the Section is responsible for the production and maintenance of foundation seed (breeder's seed) of all commercially grown field crop varieties resulting from the Breeding Program of the Institute. The foundation seed is used as pre-basic seed for the production of certified seed sold to farmers. Cooperation with international centers such as CIMMYT and ICARDA continue as new genetic material is received and evaluated continuously. The Section has also the responsibility for the management of the Genebank and the National herbarium. It is also in charge of the coordination of issues related to Plant Genetic Resources for Food and Agriculture. Additionally, research work is carried out on potatoes and aromatic plants.

The breeding program for bread and durum wheat continues. Two new varieties of bread wheat were registered in the National Catalogue. Particular emphasis has been given to the improvement of productivity of legumes by genetic purification of commercially grown varieties, and the introduction of new varieties of vetch, peas and chick peas. The collaboration with international centers such as ICARDA, CIMMYT and The Borlaug Foundation (through ARO) was continued with good results since it enhances the gene pool that is used for the ARI wheat breeding program.

The common vetch varieties 'Kimon' and 'Zinon' were registered in the National Catalogue of Cyprus and 'Kimon' is already available to farmers through the Seed Production Center.

Following a request from the Department of Agriculture, ARI has intensified its efforts on generating at least one new variety of triticale that would be suitable for the climatic conditions of Cyprus. At least one of the promising lines of this program will likely be sent to the Variety Examination Centre for registration in the next cultivating season 2013 -2014.

Three new varieties of ground nut successfully completed their examination

period and are going to be listed in the National Varieties' Catalogue in 2013.

Barley breeding represents a prominent activity, as barley covers the largest cultivated area among all cereals and is a staple for animal husbandry, both as hay and feed. Two new genetic lines were advanced to the Variety Examination Center for registration. Organic barley production is important for the sustainable development of organic agriculture. Crosses were performed between Cypriot lines and promising imported material from countries that possess typical Mediterranean climate type, such as Australia. Trials of promising genetic material were performed in four locations across Cyprus. Experiments emphasize the creation of drought-tolerant cultivars, for conditions of conventional and organic agriculture. In addition, emphasis is given to "naked barley" which is suitable for human consumption, as recent medical research has proven the multiple benefits of barley to human health. Naked barley is particularly suitable for the diet of monogastric animals. A novel program on participatory breeding was initiated, where local farmers actively participate in the creation of new, improved barley cultivars. There is ongoing collaboration with ICARDA-CIMMYT, the University of Adelaide, and the ECPGR (European Cooperative Program on Plant Genetic Resources) Working Groups for Barley and "on farm conservation of genetic resources". In addition, student training was systematically implemented for one individual from TEI for six months.

A new breeding program of local cowpea varieties is ongoing. The program has already resulted in promising selections within local cowpea varieties and the use of GIS methods to define the crop's irrigation requirements. The first year of participatory selection in farmers' fields produced interesting selections that need to be further evaluated.

A new project was initiated involving the *in situ* conservation of traditional local vegetable varieties. The first case study has been using local eggplant populations.

Seed collection has focused on material threatened by genetic erosion or extinction. In collaboration with the Department of Agriculture, research activity has continued, aiming to link *on farm* with *ex situ* activities for the conservation of vegetable landraces. In a joint collection mission with ICARDA and the Margot Forde Germplasm Centre, 252 accessions of crop wild relatives have been collected. The research program "Ensuring the survival of endangered plants in the Mediterranean", targeting the collection and *ex situ* conservation of 150 accessions of native taxa facing extinction or genetic erosion, has continued. The program is funded by the MAVA Foundation with the participation of Genebanks from all the Mediterranean islands. So far, 82 accessions have been collected.

Regeneration activities have focused on accessions with low seeds in stock and/or with low germination capacity. Faba bean, coriander, rocket and wild wheat and barley accessions have been successfully regenerated.

The characterization and evaluation of durum wheat genetic material has continued. Part of the genetic material concerns local landraces conserved by the ARI Genebank.

In collaboration with ICARDA, the KEW Gardens and the University of Birmingham, a joint collecting mission of herbarium specimens was organized in May 2012. In total, 333 herbarium vouchers have been collected mostly from native plants of crop wild relatives.

In collaboration with the University of Birmingham, a National Strategy has been developed for the *in situ* and *ex situ* conservation of native plants that are wild relatives of crops. For the development of the strategy, 180 native wild plant species that are relatives of globally or regionally important cultivated species have been selected.

A new scientist responsible for aromatic and medicinal plants has joined the Plant Improvement Section in 2010. Research will be carried out regarding cultural techniques required for the main aromatic and medicinal plants grown in Cyprus. Research emphasis will be placed on essential oils and their properties. The experiment on the impact of deficit irrigation on spearmint (*Mentha spicata* L.) biomass production, oil yield and oil quality has continued during 2012. Also, a stevia (*Stevia rebaudiana* Bert.) plantation was established in order to investigate the possibility of stevia cultivation to Cyprus climate conditions and the economics of this crop with the intention of providing alternatives to the Cypriot producer.

Research on potatoes continued with the evaluation of potato varieties and clones with emphasis on material with coloured flesh.

4. VEGETABLE AND ORNAMENTAL CROPS

Research activity in the Vegetable and Ornamental Crops Section concerns the optimization of vegetable and ornamental crop production and the postharvest handling of fresh produce. Of particular interest is the impact of preharvest factors such as varietal selection, grafting and crop management on quality and postharvest performance of fresh produce. The potential for valorisation of endemic species in commercial floriculture remains a focal research topic for ornamental crops. Postharvest research further entails the evaluation of alternative, non-chemical applications for the control of physiological and pathogenic agents of postharvest quality deterioration and senescence.

The impact of grafting watermelon cultivars on hybrid rootstocks has been examined with respect to field performance, fruit quality and storage performance. Results have been submitted for peer-reviewed publication. In progress is the examination of the effects of harvest maturity on fruit quality and shelf-life. New small-fruited and seedless watermelon cultivars grafted onto different rootstocks are evaluated for yield, quality and storage performance.

Yield, quality and nutritional safety characteristics of four salad crops (lettuce, spinach, rocket, and cilantro) are evaluated with respect to the impact of nitrogen fertilization strategies in soil and soilless cropping systems. Emphasis is placed on nitrate and nitrite transitional concentrations pre- and post-harvest, in tandem with other important biochemical and physical indices of quality and safety.

The effect of salinity is examined on hydroponic production of lisianthus (*Eustoma grandiflorum*) with respect to the type of substrate, the crop's developmental stage at the time of stress application, and the seasonal effect. Response to salinity, induced by sodium and chloride ions in the nutrient solution, will be evaluated in terms of productive, morphological, qualitative and vase-life characteristics of lisianthus.

Further research on ornamental crops entailed work on the valorisation of endemic species in commercial floriculture. Endemic ornamental species, propagated and cultivated in the context of a recently concluded research project, have been promoted for commercial nursery potted-plant production and for use in landscaping. A new project under preparation concerns the development of propagation and cultivation protocols for indigenous tulip species *Tulipa agenensis* for commercial production.

In an interdisciplinary project, under the coordination of the ARI Postharvest Technology Laboratory, an *ex situ* collection of 29 local pomegranate (*Punica granatum*) clones has been established at the Zygi Experimental Station. The clones will be evaluated for their pomological, qualitative and technological characteristics, their antioxidant value and postharvest performance.

5. PLANT PROTECTION

Plant Protection research projects concern the disciplines of Plant Pathology and Entomology. Specialized scientific studies are conducted to address major crop protection problems associated with particular pests (insects, mites) or diseases (viruses, viroids, bacteria and fungi). Among the main activities of the Plant Protection Section is the development of integrated pest management (IPM) strategies, based on various combinations of ecosystem-oriented methods, including biological control, cultural practices, natural products, resistant varieties, resistant rootstocks and minimal use of selected, mild pesticides. This approach ensures sustainability and minimizes pesticide risk to human health and the environment. It can be applied alone or in combination with other ecosystem-oriented production practices, in the context of an advanced system of sustainable agriculture, known as integrated crop management (ICM). In addition, joint multi-disciplinary research projects targeting all important pests and diseases of particular crops are undertaken. These studies are governed by the considerations of sustainability in crop protection and production, food quality and safety, environmental protection and the utilization of new technologies for the development of more effective crop protection practices.

Studies in Entomology concerned the biological control of Kelly's citrus thrips (*Pezothrips kellyanus*) on organic grapefruits using botanical insecticides, development of IPM programmes in greenhouses and open fields, rearing and release of "beneficial" insects, development of automated warning systems for monitoring the Mediterranean fruit fly (*Ceratitis capitata*) and the California red scale (*Aonidiella aurantii*) and monitoring and management of insect pests in pomegranates. In collaboration with the Agricultural University of Athens and the National Agricultural Research Foundation of Greece, the integrated control of phytophagous mites of the Tetranychidae family as well as the resistance levels of the two-spotted spider mite *Tetranychus urticae* to various insecticides and acaricides was studied.

A new international project coordinated by the International Atomic Energy Agency was initiated in 2012. Beside Cyprus, twelve more countries are cooperating with the objective to enhance agricultural productivity in the Balkans and the Eastern Mediterranean, by supporting fruit fly pest prevention and management. Also a two-year research project was funded by the Cyprus Research Promotion Foundation, aiming at studying the bio-ecological and molecular aspects of red palm weevil *Rhynchophorus ferrugineus* and palm borer *Paysandisia archon* and recommending measures for their integrated control in palms of Cyprus.

Long-term projects are currently implemented for the maintenance and distribution of healthy, true-to-type, propagating stock material of citrus, grapevines and stonefruits. The production of these plantations complies fully with the EU directives on Plant Health. Currently, pathogen-free material of citrus, grapevines and stonefruits is maintained in insect-proof screenhouses in the form of Prebasic Plantations. These are used to provide the Department of Agriculture and the private sector with pathogen-free mother stock (basic material), for further propagation and production of certified propagating material for growers.

In view of a national long-term project, aiming at *Citrus tristeza virus* (CTV) management and characterization, a new diagnostic protocol was developed and optimized. The protocol is suitable for the generic detection of all virus isolates associated to severe or mild symptoms in the Mediterranean basin. In addition, for the discrimination of virus strains in Cyprus, new specific molecular probes were designed and are currently being evaluated.

Pepino mosaic virus (PepMV) was first reported to infect tomato crops in Cyprus in 2009. During 2012, biological and molecular characterization of several isolates was performed. Results showed that Cypriot strains were able to infect many commercial tomato varieties, eggplant, as well as different weeds. These isolates are clustered within the Chile-2 strain of PepMV, which is widespread in Europe.

Whitefly transmitted viruses that belong to the genus *Begomovirus* and *Crinivirus* are associated with severe economic losses in cucurbit and tomato crops in Cyprus. In Cyprus, research has showed that the *Cucurbit yellow stunting disorder virus* (CYSDV) and the *Tomato yellow leaf curl virus*

(TYLCV) are the two predominant virus species in cucurbits and tomatoes, respectively. The TYLCV host range includes 49 different weed species that belong to 12 botanical families. In nature, these viruses are transmitted by the whitefly *Bemisia tabaci* (Gennadius).

Globodera pallida and *G. rostochiensis* are two cyst-forming nematodes (PCN) known to infest potato crops, causing severe economic losses worldwide. In collaboration with the Cyprus University of Technology, a novel real-time PCR assay was developed and optimized for the simultaneous detection of the two PCN species. The developed assay, allows the simple, accurate and cost-effective testing of a large number of cyst samples, and can be applied in surveys and certification schemes.

Plant Pathology and Entomology laboratories provided support for the scientific identification of plant pathogens and insect pests, in samples provided by the Department of Agriculture, agriculturists from the private sector and farmers. In 2012 more than 3000 samples were processed.

6. SOIL SCIENCE

The activities of the Soil Science Section concern soil fertility improvement, plant nutrition, soilless culture, irrigation of crops and agricultural engineering.

The research on the improvement of soils focused primarily on the possibility of inclusion of grain legumes in crop rotation systems. A series of laboratory experiments was conducted to assess the nitrogen mineralization rate in soil samples taken at the end of a growing season with these legumes. Results were correlated with the size of wheat productions obtained at the same experimental plots that had previously been cultivated with grain legumes.

The research work for the composting of organic waste and debris continued with the evaluation of stability and biological characteristics of different types of compost that were characterized by the same carbon-to-nitrogen ratio of the feedstock mixture.

Research activities in crop irrigation and integrated water resources management in Cyprus, are focused on the possible long-term effects of wastewater reuse for irrigation, both in environmental and public health terms. A survey is underway to evaluate the long-term consequences on soil physicochemical parameters, from the long-term wastewater reuse in various provinces of Cyprus. In the frame of this research, vegetables crops are being irrigated with treated wastewater effluent from the Municipal Wastewater Treatment Plants (MWTP) of Limassol and Anthoupoli, and control water abstracted from a well. Results indicate that no constraints exist for the incorporation of treated wastewater to the national water balance. In addition, research is undertaken in order to evaluate the fate of wastewater organic micro-pollutants in plants and the environment in general.

In plant nutrition and soilless culture activity focused on both education and research.

Work at the Educational Centre on Hydroponics has continued with the training of Agronomists from the Department of Agriculture for the second consecutive year, aiming at the acquisition of advanced skills in the management of hydroponic systems. Also the training center was used to train farmers, students and foreign visitors. Finally, an effort of writing a manual for hydroponics has commenced.

Soilless culture experiments concern greenhouse vegetables and particularly strawberry and aromatic plants in order to generate up-to-date, practical and location-specific information. 'Festival' and 'Ventana' appear to be interesting alternative strawberry cultivars. These cultivars attained early fruit production with large fruits of good taste quality and good efficiency in water management when today growers are under increasing pressure to increase water efficiency in several horticultural crops. However, 'Camarosa' produced fruits with higher antioxidant compounds and a more attractive color. The type of coco-substrate was not a limiting factor.

Plant nutrition aspects were examined, in conditions that nutrients in water for irrigation exceed recommended values. If the water used to prepare the nutrient solution for hydroponic strawberry crops contains more calcium (Ca) than recommended, potassium (K) and magnesium (Mg) should be either maintained to standard levels or reduced slightly to minimize or avoid any Electrical Conductivity (EC) increase, owing to the excess Ca. An increase of K and Mg levels, in addition to that of Ca, to maintain a standard recommended K:Ca:Mg ratio is not suggested, because it raises the EC in the root zone to harmful levels for growth and fruit yield. Further, not adding additional amounts of nutrients could prevent environmental pollution and wasteful expenditure.

The Soil Science Section has also been participating in E.U. projects, whose main objective is to adapt farming to climate change and to limited water resources.

Research in agricultural engineering concerns the potential use of biomass for biofuel (biodiesel, bioethanol, biogas and solid fuels) and energy production under Cyprus conditions. The main scope of this effort is the selection of appropriate energy plants that produce sugars or starch or woody biomass with minimum irrigation water requirements. The studied plants are selected so that they do not interfere with the food or feed chain. An ARI Project continued, in order to develop a filter to clean the fuel gases emitted from boilers burning biomass for heating of greenhouses. The European research project «Adapt2Change» (LIFE + 09 ENV/GR/000296), "Adapting farming to climate change and to limited water resources" continued this year. In this project the use of shallow geothermal energy for heating greenhouses, combined with innovative techniques for water saving irrigation in greenhouses are studied. The Program «AGROCHEPACK» (MED 2G-MED09-15), "Design of a management system for plastic packaging of agrochemicals, for environmental protection and recycling of plastic" continued with the construction of the Pilot Plant for the collection of the packages to be recycled. The aim of the project is to design a management system for the agricultural plastic packaging waste starting from the farmer up to the recycling of the material.

The “GreenFilm” Project has also continued in 2012. It is funded by the Cyprus Research Promotion Foundation and it concerns the testing of new technology greenhouse plastic covers, which contain nano-particles as pigments. These pigments offer special properties to the cover.

The European ENPI Project: “MED-ALGAE”, which involves the study of the growth of micro-algae for the production of biodiesel, has commenced in 2012. ARI is the leading partner and, thus, coordinates this project.

7. ANIMAL PRODUCTION

The research activities of the Animal Production Section involve work on ruminant nutrition, management, animal breeding, genetic improvement and physiology of reproduction. Research is generally directed towards increasing milk and meat yields under semi-intensive or intensive systems of management in sheep, goats and dairy cattle. In addition, genetic methods and animal husbandry practices are employed, aiming at controlling and/or preventing animal diseases.

In animal nutrition, a feeding regime is implemented according to the production stage of the animals. Also, a research project is in progress, on the use of triticale hay and silage in the diet of cows, sheep and goats, and its effect on milk production and composition, and on the animals’ weight at the onset of lactation.

In animal breeding, the research work aims at improving the genetic stock with respect to important economic traits in livestock using within-breed selection methods. Genetic evaluations of Chios sheep and Damascus goats are based on selection indices that combine the individual capacity for growth of young animals and the milk yield and composition of female ancestors. This method is routinely used at all government breeding units for the evaluation and selection of superior breeding stock in sheep and goats.

Further research in genetic improvement is directed toward dissecting the genetic aspects underlying milk production in sheep, and further characterising Scrapie genotypes in goats. An extensive genetic study of Chios sheep milk production has been conducted, as part of a three-year research project, funded by the Cyprus Research Promotion Foundation. This project was pursued in collaboration with the Cyprus University of Technology and other research institutions. The most significant outcome of the project was the identification of a novel polymorphism in a specific gene, named *ACAA2*, and its significant association with increased milk production. With regard to further characterization of Scrapie genotypes in Damascus goats, this is pursued through an ARI-funded project, in which relevant information is collected, in order to examine potential association between Scrapie genotypes and productive and reproductive traits.

Research programmes in the area of reproductive physiology of farm animals aim at improving reproductive performance. In this regard, genetic and

environmental factors that influence seasonal reproduction, reproductive development and puberty in sheep and goat breeds under local conditions are examined.

The project for combating the Scrapie disease in Chios sheep, with the use of genetic methods, is being successfully implemented at ARI. The Chios sheep unit at Athalassa has been transformed into a nucleus herd of Scrapie-resistant genotypes of high genetic value. All the animals in the nucleus herd are of the homozygote ARR/ARR genotype, considered to be 100% resistant to the disease. A large number (174) of young rams and surplus females (171), along with adult rams (25) and ewes (32) were issued to farmers in 2012 in order to improve the genetic stock and productivity of their flocks and to further increase the frequency of resistant genotypes in the Cyprus sheep population. It must be noted that, since the project commenced in 2002, ARI has provided the farmers with more than 3800 Scrapie-resistant Chios sheep of high genetic value.

In mid-2008, a research program commenced to transform the ARI Damascus goat herd into a nucleus of 300 Scrapie-resistant genotypes, through targeted matings. This program allows ARI to issue to farmers animals that are resistant to the disease, in order to combat Scrapie in the Cyprus goat population. Specifically for 2012, 13 goats, 27 bucks, 74 male and 13 female kids were given to goat farmers from ARI. All the animals were of superior genetic stock and genotyped for the Scrapie locus.

In farm management, the evaluation of artificial rearing systems using automated feeders and milk substitute for lambs and kids has continued in 2012. Results showed that such systems can be used to increase the marketable milk with no adverse effects on lamb and kid growth. Lambs and kids on zero suckling were reared artificially on milk substitute using automated milk feeding machines. Marketable milk of mature ewes on zero suckling was 70 kg more than ewes that suckled their lambs for 35 days and that of mature goats 85 kg more than goats that suckled their kids for 49 days. Further research comparisons of reduced suckling period, both for natural and artificial rearing (28 versus 35 days for lambs and 42 versus 49 days for kids) are in progress. It is worth noting that research results and recommendations from this nutritional and management scheme have immediate and important financial benefits for breeders.

The Animal Production Section is also active in the field of conservation of animal genetic resources. Priority is set on preserving local breeds of farm animals and on collaboration with international organisations, such as the Food and Agriculture Organisation (FAO) and the European Regional Focal Point on Animal Genetic Resources for the implementation of the "Global Plan of Action for Animal Genetic Resources and the Interlaken Declaration". For this purpose, the aforementioned document has been translated in Greek for wider dissemination within the public. Within the context of research on animal genetic resources, ARI participates in a European research project, in which Mediterranean countries collaborate on topics of agricultural research. The project (acronym DoMEsTic) aims at examining the factors affecting the

sustainability of Mediterranean sheep and goat production systems, with respect to the genetic management, and the environmental, economic and societal specificities of the region.

8. RURAL DEVELOPMENT

The Rural Development Section carries out research related to the fields of Production Economics, Marketing of agricultural products, ICT and Robotics in Agriculture, and Rural Development through the research program “Rural Development and Trading of Agricultural Products”. The research program’s website is at <http://ruraldev.ari.gov.cy>.

The Section coordinates the research project “Information and Communication Technologies for Rural Development”. The aim of the project is to improve the access of farmers to agricultural information (especially related to agricultural research results), by taking advantage of the capabilities of computers and the internet. Activities in agricultural economics pertained to the execution of a survey regarding the status of farmers’ access to scientific results relating to agriculture, to techno-economic analyses and the participation to EU funded projects.

Researchers of the Rural Development Section represent ARI in three EU funded programs: the Cooperation Projects “Agricultural Research in the Mediterranean (ARIMNet <http://www.arimnet.net>), and “Facing sustainability: new relationships between rural areas and agriculture in Europe” (RURAGRI <http://www.ruragri-era.net>), and, as of June 2010, in another EU funded project called “Virtual Open Access Agriculture and Aquaculture Repository” (VOA3R <http://voa3r.eu>). They also represent ARI in three projects funded by the Research Promotion Foundation (RPF): Supporting role of robotic technology for sustainable agriculture (Agrirobot – <http://agrirobot.ouc.ac.cy>), “Options for sustainable agricultural production and water use in Cyprus under global change”, and “Development of a system by combining the use of communication systems and space images for informing farmers about watering issues”.

Recently, a Remote Sensing Laboratory has been established at the Achelia Experimental Station of ARI. The Laboratory is already collaborating with other sections and is participating in a research program regarding the estimation of Evapotranspiration, funded by the Research Promotion Foundation of Cyprus.

The Section’s information technology (IT) domain maintains the local area network and provides internet and email access to the ARI staff members. The ARI has implemented its own website at <http://www.ari.gov.cy>, through which it provides information describing the work of the Institute and publishes news and events that take place at ARI. It also maintains the local area network (ARINET), provides internet access to all professionals at ARI, and participates in EU-funded cooperation programs. All ARI publications dating from 1962 till today have being digitized and all bibliographical data, including

full text articles of the publications, are available through the library web page at <http://library.ari.gov.cy/agris>.

In order to improve the dissemination of the agricultural research programs and inform the public about news and activities of the Institute, the Section has created an electronic newsletter (e-Newsletter) which is published every 3 months and is e-mailed to subscribers. It has also created a web blog of the Institute, at <http://blog.ari.gov.cy>, it maintains a Twitter account at http://twitter.com/ari_rd, an Issuu account at http://www.issuu.com/ari_rd, and a Slideshare account at <http://slideshare.net/ARIWebinars>. The main advantage of using the aforementioned social media services is that they strengthen the communication between ARI researchers and stakeholders, and it improves the agricultural research results dissemination, by reaching the continuously increasing number of internet users.

Finally, the Section represents Cyprus at the Association of Agricultural Research Institutes in the Near East and North Africa (AARINENA). It is also a member of the Global Agricultural Research and Development Web Ring, and of the Food and Agriculture Organization of the United Nations (FAO).

9. AGROBIOTECHNOLOGY

The research activity of the Agrobiotechnology Section focused accordingly on molecular biology, food science, agricultural microbiology and agricultural chemistry through the submission of research proposals in collaboration with other Sections of the Institute.

Research in molecular biology is conducted on plants and animals using specialized molecular methods. Research on plants focuses on the exploitation of molecular markers for barley. Watermelon colonisation by arbuscular mycorrhizal fungi was assessed using real-time PCR. Molecular biology techniques were used for the identification of fast pesticide-degrading bacteria as well as nitrogen fixing bacteria. Genetic markers are under development for the discrimination of different *Eruca sativa* ecotypes collected within Cyprus. In addition, quantitative and qualitative tests for the presence of genetically modified seeds in imported corn and soybean were carried out. On animals, research continued with the molecular fingerprinting among the different genotypes of goats. Sheep identification was conducted on newborn animals kept at the ARI nucleus unit, which comprises 500 breeding animals (ARR/ARR genotype), fully resistant to scrapie. Goat identification is a continuous procedure to establish a nucleus unit with known scrapie genotypes.

The upgrading of the food technology laboratory continued in 2012. Researchwise, the antioxidant and antimicrobial properties (*in vitro* and *in vivo*) of natural products such as essential oils and plant extracts are being investigated. Moreover, the effect of food processing on product nutrient and anti-nutrient content is part of a continuous research activity of the lab. Finally, the impact of treated waste water use on the microbial load of fruits and vegetables is being investigated.

Research in agricultural microbiology relates to bioremediation of pesticides used by Cypriot farmers. Bacteria able to degrade pendimethalin were isolated and characterized. The fate of this herbicide in soils was also evaluated and degradation kinetic models were implemented. We examine the impact of co-inoculation of cowpea plants with nitrogen fixing bacteria and mycorrhizal fungi on plant growth, and their nutrient status under nitrogen deficient conditions. The inoculants used were previously isolated from local cowpea ecotypes through a screening procedure and characterized using molecular techniques. Moreover, richness of autochthonous mycorrhizal assemblages in different local cowpea ecotypes was assessed. Research regarding the impact of compost teas on soil microbial community structure and mycorrhizal colonization as well as plant growth and nutritional value of the products was conducted. The evaluation of the antimicrobial activity of *Eruca sativa* seed oil and mint essential oils was initiated.

Three analytical methods were developed in the agricultural chemistry laboratory. The first one concerns the quantification of pesticides mainly in soil, the second involves extraction and quantification of essential oils from mint using microwave radiation and the third one concerns the digestion of components for nutrient analysis, also using microwave radiation. The agricultural chemistry laboratory performed 9,750 chemical analyses on 2,136 samples during 2012.

10. VARIETY EXAMINATION CENTER

DUS trials (Distinctness – Uniformity - Stability): During the growing season 2011/12, one triticale variety (CS TCI) and one barley variety (Pygi) were tested for the second year. The results were submitted to the Designated Authority (Department of Agriculture).

VCU Trials (Value for Cultivation and Use): During the growing season 2011/12, one triticale variety (CS TCI) and one barley variety (Pygi) were tested for the second year. One alfalfa variety “Ntopia” was tested for the third year. The results for the three crops were given to the Department of Agriculture. In addition, two wheat varieties (“Acheleia” and “Giolou”) were registered in the National Catalogue of Varieties.

Additionally, a research proposal is in progress, concerning the cultivation of fodder plants. The title of the proposal is “Optimization of hay cereal yields to feed sheep and goats in Cyprus”. In the first year, five different varieties of five different species in four different growing stages were evaluated. The above variables of variety and cutting stage were categorized according to quantitative and qualitative criteria.

11. FARM ACCOUNTANCY DATA NETWORK

The operation of the Farm Accountancy Data Network (FADN) was launched in 1965, when Council Regulation 79/65 established the legal basis for the organization of the network. It consists of an annual survey, where the Liaison

Office collects accountancy data from a sample of agricultural holdings. It refers to physical and structural characteristics of the holdings like the cultivated area, the number of livestock raised, the labor capital, as well as economic and financial data such as subsidies received, costs and returns, etc. The participation of farmers in the sample is voluntary. All the information collected by farmers is strictly confidential and submitted only to the General Directory of Agriculture. The data is used to estimate the agricultural income in all member states, as well as to propose adaptations and modifications to the existing Common Agricultural Policy.

In 2012, the FADN unit held the presidency of the FADN National Committee and represented Cyprus to three meetings of the FADN Community Committee in Brussels. The main issues discussed during the meetings concern the alignment of FADN to meet the future changes of CAP for the period 2014 - 2020.

In 2012, reports for 479 farm returns for the accounting year 2011 were submitted to the European FADN Committee. The data was collected through personal interviews from a representative sample and processed according to the relevant regulations and procedures. Furthermore, the relevant software assisting the import and processing of data submitted to the Public Database of FADN was also updated. During the year, data from a representative sample referring to the accounting year 2012 was also collected.

In October 2012, after the approval of the National Monitoring Committee, Cyprus submitted to the EU FADN Committee the 2013 selection plan for holdings participating in the FADN sample.