ICARDA Laboratories

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Agronomy Laboratory

Location: Lab III

Purpose: to handle all plant and seed samples and to measure yield parameters and soil moisture for the agronomic research trials and assist other projects for such measurements as needed.

Senior Scientist: Mustafa Pala

Lab Supervisor (in charge): Mr Haitham Halimeh and Mr Atef Haddad

Names of Other Staff in Lab: Mr Ahmed Haj Dibo
Mr Farouq El Mohamed
2-3 women labors

Work/Measurements: Seed and fertilizer preparation; Plant counts, dry matter, leaf area, plant height, seed count, 1000 seed weight, for wheat, barley, lentil, chickpea, faba bean, forage, oil seeds, cumin, coriander, maize and cotton and oil extraction for oilseed crops; Herbicide weighing and preparation.

Facilities Available: Oven, refrigerator, leaf area meter, seed counter, electronic balance, oil pressing machine (0.5-1 l/hour capacity)

Activity per annum:

Measurements	**Sample #**
Leaf area and plant dry matter in cropping season	192
Seed count & 1000 seed weight	1511
Crop harvest processing	2260
Soil sample process (moisture)	896
Oil extraction	250

Animal Research Laboratory

This includes an experimental flock/herd of small ruminants, an animal nutrition and health lab, and a milk processing plant.

Purpose

The experimental flock/herd supplies animals for research in animal nutrition, management, reproduction and breeding.

The animal nutrition and health lab primarily supports research in animal nutrition, targeting the quality analysis of feeds, milk and milk products. Its health lab component provides supports for general assessments of infestation of external and internal parasites.

The milk processing plant supports research on and production of dairy products, looking at solving problems confronted by farmers in processing of milk into milk-derived products, production diversification and training.

All these units are also used to train NARS, research collaborators and farmers.

Senior Scientist: Luis Iniguez, livestock specialist

Lab Supervisors: Monika Zaklouta (animal research laboratory in general)
Muhi El-Dine Hilali (animal flock and heard and milk plant)

Supporting Staff: *Nutrition and health lab*: Safouh Rihawi (Animal nutritionist, conducts animal nutrition research),
Mohamed Haylani (GS, specialized in chemical analysis), Rima Dabbagh (lab assistant for general chores, local consultant), Ghouzun Sebai (lab supporting, daily) and 3 additional daily labors for field operations lab and milk plant operations
Milk processing plant: Maha Addas (GS, emphasis on milk processing)
Experimental Flock/herd: Ghazan Jesri (veterinarian, local consultant), Ahmed Sawas (GS, supporting animal nutrition work), Adel Hwish (local consultant for on-farm work), and 13 dailies for field operations.

Summary of Tests/Facilities Available: *Basic analysis of the nutritional value of feedstuffs*, this including: protein (Kjehldal), ADF/lignin, NDF, digestibility (*in vitro, in vivo*), fat (Soxlet), minerals (Atomic absorption spectrophotometer, spectrophotometer and flamephotometer), Gas Production Test (Hohenheim method), vitamins, organic acids (HPLC, GC)
Milk composition analysis (Milkoscan) including Protein, Fat, Lactose, Solids non Fat, and milk quality via liquid and gas Chromatography
Sensory panel tests for quality of meat and dairy products
Progesterone analysis using Elisa Complete facility for indoor feeding and nutrition experiments
Milking parlor for daily milking of flock and individual recording of sheep milk
General microbiological tests for milk and milk products

Activity per annum:

- Analysis of feeding values average 4,000 samples of feedstuffs and 6000 samples of milk.
- 23 ton of sheep and goat milk transformed into yogurt and cheese.
- During last season sensory panel tests on 4 experiments have been conducted (Sample size between 36 and 60 animals).
- The Experimental flock/herd consists on about 450 head of Awassi sheep including a line of highly producing animals from Turkey and about 50 head of Damascus (Shami) goats.
- Annual revenues from sale of animals, wool and dairy products are around USD 45,000.

Biopesticides Laboratory

Purpose: Develop biopesticides based on entomopathogenic fungi for the management of Cereal and Legume Insects Pests in CWANA.

Senior Scientist: Mustapha El Bouhssini

Key Partners: The University of Vermont and CABI Bioscience

Lab Supervisor: Mr Ziad Sayyadi

Names of Other Staff in Lab: Ms Amera Masri

Summary of Tests/Facilities Available:

- A sterile flow hood (Biosafety chamber level II containment) for fungal isolation and inoculation.
- Two rooms for mass production of entomopathogenic fungi.
- Binoculars/Microscopes for the identification of entomopathogenic fungi.
- One deep freezer (-80°C) for long term storage of entomopathogenic fungi.
- The lab is split into two floors, and upper floor is used for carrying out bioassays with entomopathogenic fungi.
- Two incubators for characterizing entomopathogenic fungi under different temperatures.

Activity per annum

- Characterization of hundreds of entomopathogenic fungi under different temperatures.
- Carrying out bioassays on efficacy of different concentrations and formulations of entomopathogenic fungi for Sunn pest control.
- Carrying out efficacy and persistence trials of entomopathogenic fungi in the field at Tel Hadya and in several countries in the region.
- Training of NARS scientists and technicians.

Cereal Quality Laboratory

Purpose: A few years ago, improvement of traits associated with productivity (yield potential, resistance/tolerance to biotic and abiotic stresses) was the main focus of most breeding programs in CWANA and end-use quality improvement was not considered a high priority. However, recently due to the notable improvements in productivity and self-sufficiency in a number of countries and to the liberalization of grain markets end-use quality has become of great importance. Thus the main goal of the Cereal Quality Laboratory at ICARDA is to assist breeding programs (Barley, Bread wheat and Durum wheat) in identifying genotypes of good end-use quality characteristics to be made available to NARS.

Name of Facility: Cereal Quality Laboratory

Senior Scientist: _

Lab Supervisor: Fuad Jaby El-Haramein, Research Associate (1980-)

Names of Other Staff: Ahmed El-Saleh, Research Assistant (1992-)

Summary of Tests/Facilities Available:
In Central and West Asia and North Africa (CWANA) wheat (both bread and durum) is the principal food source for the majority of the population, which on average consumes more than 185 kg/capita/year; the highest per capita consumption in the world. Bread wheat (BW) is predominantly used in the preparation of various types of bread (from flat to leavened bread) in addition to cookies and pastry products. BW grain hardness and gluten protein characteristics influence the quality of its end-use products. Medium-strong to strong gluten type and balanced to extensible gluten character satisfy the quality attributes needed for most BW products.
Durum wheat (DW) is used world-wide for the production of pasta and in CWANA it is used for bread making in addition to specific regional dishes (Ferika and Couscous). Vitreous kernels, medium strong to strong gluten, and high yellow pigment content satisfy the quality attributes needed for most DW products.
Barley is a major staple food in several regions of CAWNA and in the Andean countries. Barley grain is used for malt and human food and in addition, both grain and straw are used as animal feed. At ICARDA work on the improvement and utilization of barley germplasm as human food began in 1996 in response to NARS demand and interest in malting barley has increased recently. In addition to tests to determine desirable kernel color, size, and protein content, other tests for Beta-glucan content, kernel hardness, husk percentage, and cooking time are important quality indicators for food barley. Lignin and digestibility are important parameters for straw quality while kernel plumpness, low protein and high diastatic power are the major parameters for malt quality.

The table below lists the routine tests carried out at the Cereal Quality Lab to determine the end-use quality of BW, DW and barley; facilities available or used procedures for those tests are listed are also listed:

TEST	WHEAT		BARLEY	Facilities Available/Procedure used
	BREAD	DURUM		
1000 Kernel Weight	+	+	+	Seed Counter, Numigral X 5
Test Weight	+	+	+	Ohaus Filling Hopper with 0.5 liter vessel
Kernel Plumpness	-	-	+	European normal sorting sieve system
Kernel Hardness	+	-	+	Foss/NIRSystem model 5000

Kernel Color	+	-	+	Visual Score
% Vitreous kernel	-	+	-	Visual Score
Yellow Pigment	-	+	-	AACC method No. 14-50
Husk Percentage	-	-	+	Seedburo barley pearler
Flour Milling	+	+	-	Buhler laboratory mill MLU-202
Protein Content	+	+	+	Foss/NIRSystem model 5000
SDS Sedimentation	-	+	-	Dexter et al. (1980) Can. J. Plant Sci. 60:25-29
Beta Glucan	-	-	+	Foss/NIRSystem model 5000
Farinogram	+	+	-	Brabender 50 g Farinograph, for measuring Gluten strength
Alveogram	+	+	-	Chopin Alveograph Model MA 82, for measuring dough strength and elasticity
2-Layer Flat Bread Baking	+	-	-	Williams et al (1988), J. Cereal Sci.7:195-207
Cooking Time	-	-	+	LABCONCO crude fiber testing equipment
Straw Quality	-	-	+	Foss/NIRSystem model 5000 for determination of ADf, NDE lignin and digestability
Activity per Annum (Samples)	**7000**	**5000**	**25000**	

List of Additional Major Equipment in Cereal Quality Laboratories	
Baking oven, stone type	Power supply, BIO-RAD 500/200
Balance, analytical, Sartorius A-120S	Refrigerated bath cerculator, Lauda RM 20
Balance, toploading, Sartorius 1264 MP	Refrigerated bath cerculator, Lauda RM 20
Balance, toploading, Sartorius GP 4102	Sample mill, Falling Number KT-30
Barley pearler	Sample mill, UDY X 6
Bran finisher, Buhler MLU-302	Scale, Toledo
Centrifuge, Hermle Z-320	Semolina purifire, NAMAD
Compressed air system, Hobby 15	Sieve shaker, RO-TAP B
Cylinder shaker, Brabender	Spaghetti drying cabinet, NAMAD
Dockage tester, Carter-Day	Spectrophotometer, spectronic 20
Dough mixer, local	Stirrer, corning PC-353
Electrophoresis horizontal slab gel unit, BIO-RAD 1405	Uninterruptible power system, 3 KVA, RTE DELTEC
Electrophoresis vertical slab gel unit, Hoefer SE-600	Vacuum cleaner, Nilfisk 80
Fermentation cabinet, National MFG. Co	Vacuum cleaner, Nilfisk 90
Flour mill, Brabender quadrumat junior	Vacuum pump, Sargent-Welch 1400
Hotplate, Fisher 284	Vibrax rotary shaker, IKA
Laboratory press, Carver C-12	Vortex shaker, K-550 GE X 2
Light box, Hoefer VIS-45	Water bath, blue M
Moisture meter, Motomco 919	Water bath, GFL 1083
Near infrared analyzer, Neotec GQA-31	Water bath, Yamato YB-121A
Oven, mechanical convection, Fisher 349	Wiley mill, intermediate

Entomology Laboratory

Purpose: Develop Integrated Pest Management Options for the Cereal and Legume Insects Pests in CWANA.

Senior Scientist: Mustapha El Bouhssini

Lab Supervisor: Mr Abdallah Joubi

Names of Other Staff in Lab: Mr Fawzi Rihaoui, Mr Al Ebrahim Zakaria, Ms Dabous Asma

Summary of Tests/Facilities Available:

- Two insect rearing rooms for screening wheat germplasm for Hessian fly and rearing of insects and their natural enemies.
- Binoculars/Microscopes for diagnosis/identification of insect pests.

Activity per annum

- Screening of thousands of breeding lines from the different breeding programs and germplasm from the genetic resources collection.
- Characterization of insect biotypes at ICARDA and in the region.
- Carrying out IPM experiments (insect surveys, yield losses, planting dates, biological control, botanical pesticides) at ICARDA and in collaboration with NARS in CWANA countries.
- Training of NARS scientists and technicians.

Genomics/Molecular Marker Laboratory (Two laboratories)

- Molecular characterization of ICARDA germplasm
- Marker-assisted selection

Senior Scientist: Dr Michael Baum

Lab Supervisor: Ms Aman Sabbagh

Names of Other Staff in Lab: Dr Wafa Choumane, Dr Peiguo Guo, Dr H Sayed, Dr Aladdin Hamwieh
Students: Mr B Lakew (PhD), S Lababidi (PhD) Ms R Mougrabi (MSc)
Bioinformatics: Mr H Simo, Ms Z Ghannam
Research technician (contracted): Ms Gemma Bacchus, Mrs Lama Hamadeh, Mr Basem Edriss,
Research technician ("daily"): Ms Z Kayyali, Ms S Al-Mahmoud, Ms D Lababidi, Mr T Istambouli, Ms A Homsi, Ms D Babdji, Ms M Al-Shilh

Summary of Tests/Facilities Available:

DNA extraction, quantification, qualification, freeze dryer, PCR machines (5), real time PCR (1), agarose gel electrophoresis (6), poly-acrylamid gel electrophoresis (6), Pipettman: manual, automatic, multichannel, image analyzer (1), spectrophotometer, shakers,
automatic sequencers (3): ABI3100 capillary sequencer, ABI377 gel based sequencer, ALF Express, -85^{0}C freezer, -45^{0}C freezer, -20^{0}C (8),
Equipment for physiological trait analysis: HandPEA, Ciras-2 (photosynthesis measurements), water potential Skye, soil moisture: DeltaT, HH2,

Activity per annum:

- In 2005: molecular characterization of germplasm accessions for Generation Challenge Program:
- 3000 accession of barley: 15 SSR ICARDA (45.000 data points)
- 3000 accession of chickpea: 15 SSR ICARDA (45.000 data points)
- 3000 accession of wheat: 3 SSR ICARDA (9.000 data points)

Genetic Mapping and Marker-Assisted Selection Assays:

- Mapping: one population per year with 200 markers in 150 lines (6000 dp)
- MAS: BYDV in barley 1000, scald in barley: 1000, Ascochyta in chickpea 500

Geographic Information Systems Laboratory

Purpose:

- Research and service laboratory
- Center-wide spatial data repository

Staff:

- Senior scientist: Eddy De Pauw
- Lab supervisor (in charge): Bashar Nseir
- Names of other staff in lab: Layal Atassi (consultant)
  Wafa Jumaa (secretary/GIS data management assistant)

Summary of Tests/Facilities Available:

- A0-plotter
- A0-scanner
- A0-digitizing table
- 6 PCs

Activity per annum:

- Scanning, georeferencing and digitizing of project-related thematic maps
- Hard-copy map preparation
- Compilation, quality control and storage of spatial data
- Downloading and storage of relevant spatial data from the Internet
- Maintenance of a center-wide satellite imagery archive
- Intensive computing for spatial data generation
- Training facility

Legume Quality Laboratory

Name of facility/Laboratory: Food & Feed Legumes Quality Laboratory

Location: Saxena Laboratory

Purpose: To assist food and feed legumes breeders in selection of promising materials by identifying genotypes which should be discontinued for one or more poor quality characteristics, and by identifying those of good overall quality, which may be advanced to future generations, or used simply as parental sources of good quality

Senior Scientist: Ali M Abd El Moneim

Lab Supervisor (in charge): Mr Hani Nakkoul

Name of Other Staff: Ms Rima Zein El din (daily labour)
Ms Nesrin Jawish (daily labour)
Ms Ahlam El Nemer (daily labour)

Summary of Tests/Facilities Available:
Food legumes : crude protein content, cooking time, cooking quality, 100 seed weight, seed size, husk percentage, seed color, fibers content, swelling capacity, hydration capacity and decortications .
Forage legumes: crude protein content (herbage and grain), fibers (ADF, NDF, Lignins), digestibility, ash, anti-nutritional factors (ANF's), tannins & neurotoxin β-ODAP in grasspea (*Lathyrus sativus*)

Facilities: Spectrophotometer meter, labconco crude fiber testing, ovens, Furnaces, seed counter, water path, shakers, dehuller, grinders.

Activity per annum:

Test	Chemical Methods	NIR	Total
Crude protein%**:**	400	8000	8400
Fibers%:	1200	6500	7700
Tannins%:	300	---	300
Neurotoxin β-ODAP%:	1200	3300	4500
Cooking time (min):	400	---	400
Digestibility%:	600	3200	3800

Microbiology Laboratory

Name of Facility/Laboratory: Top ban balance (one), Analytical balance (one), Vortex mixer (one), Hot plate stirrer (two), Laminar air flow (one), Gas chromatography unit (one), Freeze dryer (one), Spectrophotometer (one), Shaker (one), Fluorescent microscope (one), Ampoule constrictor (one), Shaker water bath (one), Autoclave (two), Refrigerators (four), Oven (one).

Purpose:

- *Rhizobium* strain isolation and purification of food legume crops
- *Rhizobium* strain evaluation for effectiveness
- *Rhizobium* strain identification
- *Rhizobium* strain selection for effectiveness and competitiveness
- Inoculum production
- Measurement of Dinitrogen fixation by using Acetylene Reduction assay (ARA)

Senior Scientist: non

Lab Supervisor: Fadel Afandi

Name of Other Staff: non

Activity in Microbiology Lab: minimum activities are carried on in microbiology lab due to the abscense of senior microbiologist.

- The activities carried on are inoculum production for food legumes (chickpea) which is usually requested by Station Operation.
- Maintenance of culture collection. In addition
- Microbiology lab provide Rhizobium strains for national programs or graduate students within ICARDA's region.

Micronutrients Laboratory

Purpose: *Selection of barley and lentil grain with higher iron, zinc and vitamin A content*

Senior Scientist: -

Lab Supervisor: Fuad Jaby El-Haramein, Research Associate

Name of Other Staff: Farida Mustafa, Research Technician
Rola Bitar, Research Technician

Summary of Tests:

Iron and Zinc Analysis
Dry ashing method, Health Canada, Ottawa, 1985, is applied for determination of iron and zinc content. The principle of dry ashing method is to prepare an ash by using heat, and then nitric acid to decompose the organic matter, and dissolve the inorganic residue in an appropriate volume of dilute hydrochloric acid. Main equipment used includes: drying oven, muffle furnace and flame atomic absorption spectrophotometer.

Beta Carotene Analysis
Colorimetric screening method is under development for determination of beta carotene content. The principle of the method is to extract the sample with acetone, hexane and water to quantify b-carotene concentration, using a spectrophotometer at 450 nm. Vitamin A content in IU is calculated as B-carotene content divided by 0.6.

Activity per annum:
1000 barley and 1000 lentil samples.

Physiology Laboratory

Name of facility/laboratory: Physiology Laboratory (re-installed in 2006)

Purpose: To measure and analyze morpho-physiological traits of plant materials under stress conditions with an aim of developing stress tolerant germplasm. Physiology Lab is utilized in close relation with Water Lab, Agronomy Lab and Soil Lab.

Senior Scientist: Masanori Inagaki, Hamid Farahani

Lab Supervisor (in charge): Masanori Inagaki (MP2)

Names of Other Staff in Lab: Tomoe Inoue, Hani Hazzam and others

Summary of Tests/Facilities Available: General measurement of plant morpho-physiological traits related to stress tolerance using the equipments, such as, leaf water potential meter, leaf area meter, infra-red thermo meter, soil moisture meter, soil auger, stereo microscope, leaf photosynthesis meter (in preparation), etc.

Activity per annum: At all seasons, plant materials grown in growth chamber are used for laboratory analyses. The analyses are extensively conducted with plant materials of different growth stages, such as field growing materials in spring, harvested materials in summer, seed materials in autumn, and seedling materials in winter.

Plant Pathology Laboratory

Name of Facility/Laboratory: Alfred Bronnimann Plant Pathology Laboratory.

Purpose: The main task of the Pathology Laboratory is to perform the accurate diagnosis of diseases affecting cereal and food legumes and determine their distribution in CWANA. Additionally, it is involved in the morphological and molecular characterization of causal organisms; development and implementation of screening techniques for disease resistance under artificial inoculation, and characterization of resistance sources among cultivated and wild relatives of cereals and food legumes.

Senior Scientists: Dr Amor Yahyaoui and Dr Bassam Bayaa

Lab Supervisor: Dr Amor Yahyaoui

Names of Other Staff in Lab: PDF: Dr Mathew Abang.
RA: Dr Chabane Kamal
Research Associates: Ms Siham Kabbabeh, Mr Munzer Naimi
Research Assistants: Mr Ziad Alamdar, Mr Samer Murad, Mr Monzer Kabakebji
Graduate Students: Mr Ali Sbeih; Mr Barakat Rahmoun; Ms Rasha Moghrabi; Mr Hossam Abeido; Ms Mayyada Kayyali; Ms Roula Shamsi, Ms Shoala Kharouf
Junior Research Fellows: Dr Kiros Meles; Ms Aida Bouajila; Mr Moez Fakhfakh

Summary of Tests/Facilities Available:
Tests: Morphology, gram, biochemical, pathogenicity, and pathogen characterization using molecular (AFLP and microsatellite) markers
Facilities: The laboratory is equipped for bench research on the diagnostics, epidemiology and population genetics of plant pathogenic fungi, bacteria and plant-parasitic nematodes. The laboratory currently shares facilities with the Biotechnology Lab for its population genetics research (based on neutral DNA markers) but is being equipped with all routine equipments for standard molecular biology work.
Major equipment includes: 2 laminar air flow hoods; incubators; growth chambers/convirons; shakers, PCR thermal cyclers; agarose and polyacrylamide gel electrophoresis systems; bench centrifuge; tabletop centrifuge; microwave oven, hot plate, water bath, two -20°C freezers; refrigerators, binoculars, microscopes (light and phase contrast), and A3 scanner. Specialized facilities include a separate room for working with soil and field samples and a shared walk-in cold room.

Activity per annum (some idea of activity/volume of through-put/usage): Activities include disease diagnosis, fungal and plant-parasitic nematode isolation, purification, characterization (conventional and molecular) and conservation, and inoculum multiplication for artificial inoculation in screening for resistance to fungal diseases. In particular;

- Preparation of inocula for screening under artificial inoculation at three experimental stations: Tel Hadya and Lattakia in Syria, and Terbol in Lebanon:
  a) Food legumes for disease resistance (6-8 ha *Ascochyta rabieie* for 12000 lines/year, 1 ha *A. fabae* for 2000 lines/year - Tel Hadya), *Botrytis fabae* for 2000 lines/year on 4000 m^2 under screen houses at Lattakia); and
  b) Cereal diseases: scald of barley (Ave.5000-7000 accessions), smuts (500 accessions), net blotch (500 accessions), root rots and nematodes (300 accessions); yellow rust (15000 accessions), leaf rust (2000 accessions) stem rust (1000 accessions), common bunt (1500 accessions), root rot-*Fusarium* spp. (1000 accessions) and nematodes-*cereal cyst nematode* (900 accessions)

- The lab manages and monitors 3 sick plots: Chickpea Fusarium wilt (2 ha) and Lentil Fusarium wilt (1 ha); cereal dry land root rots (3/4ha)
- The lab maintains different races/pathotypes of the major pathogens affecting cereals and food legumes
    - Cereals: *Yellow rust, leaf rust, stem rust, common bunt, loose and covered smut, Septoria tritici, Rhynchosporium secalis, Bipolaris sorokiniana, Pyrenophora tritici-repentis, Fusarium nivale, F. culmorum, F. pseudoraminearum.*
    - Food Legumes: *Fusarium oxysporum* f. sp. *ciceris, F. oxysporum* f. sp. *lentis, Ascochyta fabae* (25 isolates), *A. rabiei* (3 pathotypes), *A. lentis, Botrytis fabae* (20 isolates), *B. cinerea, Cercospora fabae*
    - The lab maintains different cultures of bio-agents including fungi (*Trichderma* spp., *Penicillium oxalicum, Gliocladium virens*) and bacteria (*Bacillus* spp., *Pseudomonas* spp.).
- DNA extraction from cereal and legume pathogens for subsequent AFLP fingerprinting and/or microsatellite analysis (e.g. extraction of DNA from 1,649 and 1,324 *Rhychosporium secalis* isolates in 2004 and 2005, respectively).

Seed Technology Facilities for Training and Services

The Seed Unit of ICARDA was established in 1985 to strengthen the national seed programs in CWANA region. From the outset, capacity building and services in quality seed supply to ICARDA commodity programs and NARS remain the main mandates of the Unit. To fulfil this task, the Unit established a range of physical facilities for training and quality seed production and practical training in different aspects of seed technology. Although the scope of the Unit's work has broadened and its activities diversified, these facilities still play an important role both for the national seed programs in CWANA and for the research programs and Units at ICARDA. They are used to meet the needs of the national seed programs and ICARDA commodity programs by producing limited quantities of high quality seed of the ICARDA originated varieties and for training. At the same time, the Programs and Units benefit from the processing, testing and storage facilities, which are managed professionally by the Seed Unit. This note briefly describes these facilities and their management.

Seed Multiplication Fields:
The Unit has about 25 hectares of land, which is allocated on a permanent basis within the farm rotations at Tel-Hadya. This is used for maintaining varieties, for producing limited quantities of seed of ICARDA originated varieties for research and distribution to NARS. These plots are also used for training. The crops grown are cereals and legumes and forages (e.g. vetch and Lathyrus). In addition, some land is also used for applied research and degree training of MSc and PhD students.

The amount of quality seed produced per year varies 30-45 tonnes. It comprises of 6-10 tonnes each for barley, bread and durum wheat; 3 to 5 tonnes each for chickpea, lentil and forages; and 50-100 kg for faba bean.

Seed Processing Center:
This consists of two parts. There is a 1.5 t/h capacity line comprising air-screen cleaner, indented cylinders, a gravity separator and a seed treater which can handle all crops produced on the farm. It ensures the supply and distribution of high quality disease free seed from ICARDA research center. Annually on average 300 tonnes of cereals and 100 tonnes of legume seeds are cleaned and treated from different commodity programs and Units.

An adjacent laboratory houses a collection of small scale processing machines, which are used to perform special tasks on seed samples and small seed lots. This facility handles 3,000 to 5,000 samples each year, mostly for genetic resources and breeding purposes. These small machines are also invaluable for training and demonstration, as they employ the same principles as in large machines.

Medium Term Seed Store:
The Seed Unit manages a central store where about 40,000 samples and 70-100 tonnes of larger seed lots are kept. This is provided with a raised platform for sample storage in plastic drums, while the large seed lots are stored mostly in polypropylene sacks on pallets. The store is equipped with fumigation and electronic rodent repellent facilities. The stored commodities are kept under ambient conditions because the store was originally built for machinery and was subsequently converted to its present use. Consequently it does not embody the design features of a purpose-built seed store including ventilation or insulation. It is part of our capital investment plans to replace this store.

Seed Testing Laboratory:
This has all the standard facilities of a seed-testing laboratory. It is used both for routine testing of samples of seed lots stored at ICARDA and for research in degree and degree training purposes. There is a preparation room with benches, sample preparation area and wooden shelves for sample storage. An adjoining seed testing room is equipped with all basic facilities for testing seed for quality attributes including purity, germination, moisture content and seed vigor. There is an office with a computer facilities and necessary reference publications related to seed testing. The total number of samples tested for research and quality control purposes per annum ranges between hundreds to thousands.

Staff:
All these facilities are handled by Mr Abdoul Aziz Niane, a Seed Production Manager assisted by a store keeper, Mr Mahmoud Hammadeh; a seed processing operator, Mr Hussein Battoh; and two permanent daily labours.

Soils, Plant and Water Analytical Laboratory

Purpose: Chemical and physical measurements of soil, plant and water samples

Senior Scientists: Dr Richard Thomas & Dr Francis Turkelboom

Lab Supervisor:

- Soil Fertility Unit: Mr George Estefan
- Soil Erosion Unit: Dr Zuhair Masri

Names of Other Staff in Lab: Ms Shereen Baddour, Mrs Nezha Merjaneh, Ms Lida Janbolad, Ms Zeinab Hamo, and Mr Ahmed Al Khouder, Ms Rousheen Haj-Abdo, Ms Fatima Al-Hussein, Mr Mustafa Humeidy

Summary of Tests/Facilities Available:

Soil Chemical Tests:

- Two Main Laboratories: The Soil, Plant, and Water Analysis Laboratory (3 rooms), and the Soil Preparation Laboratory (2 rooms).
- The Main Soil Chemical Analyses are:
  - Nitrogen, Phosphorus, Potassium, and Sodium.
  - pH, EC (salinity), Organic Matter, Calcium Carbonate, and Cation Exchange Capacity.
  - Available Micronutrient (Zn, Mn, Fe, Cu, and B).
- The Main Soil Physical Analyses are: Particle-Size Distribution, Moisture Content, permanent Wilting Point, and Field Capacity permanent.
- The Main Water and Wastewater Analyses (water quality) are: pH, EC (salinity), anions, and cations.
- The Main Plant Analyses are: Nitrogen, Phosphorus, Potassium, and Micronutrient.

Soil Physical Tests:

- Soil and aggregates stability:
  - Wet sieving: Macro-aggregation, micro-aggregation, and dispersion (Kemper & Rosenau).
  - Dry sieving: aggregate size distribution - Retsch 3D series - Sieve Shaker
- Soil texture - Robson' Pipette method.
- Aggregates friability - Dexter instrument
- Soil hydraulic conductivity.
- Soil water holding capacity.
- Soil and aggregates densities - bulk and particle
- Saturated paste measurements of Soil EC and pH.
- Measurements of soil turbidity - Turbidmeter and/or Spectrophotometer.
- Related preparations of soil samples for physical analysis, such as air drying, grinding, refinement, preparation of results in worksheets, and data interpretation.

Activity per annum

Soil Fertility Unit:

- The Soil Fertility Unit has played a vital role in the Research and Training Activities at ICARDA in general. However, many scientists and units wanting to have information of soil fertility parameters in their experiments.

- The present capacity of the laboratory for the soil, plant, and water analysis are between 10 and 12 thousand analysis per year.

Soil erosion Unit:

- Analysis of 200-400 soil samples of each tests/facilities listed above for MP3 project and other ICARDA's Mega Projects.
- Offering training to NARS and other collaborators with ICARDA.

Tissue Culture Laboratory

Doubled haploid production (in wheat and barley)
Development of somaclonal lines in Lathyrus
Genetic transformation of chickpea and lentils

Senior Scientist: Dr Michael Baum

Lab Supervisor: Ms Sawsan Tawkaz

Names of Other Staff in Lab: Mr Fateh Khatib (PhD student)
Contracted technician: Mrs Mouna Baalbaki, Ms N Al-Sokhny,
Technician ("daily"): Ms Kenana Sabbagh, Ms Hala Buni, Ms R Dabbagh, Ms H El-Jassem, Mr A Ali

Summary of Tests/Facilities Available:
Laminar flow benches (3), autoclave, various incubators, shakers, binocular, microscope, gene-gun (1) (in 2006), Walk-able growth-chambers $12m^3$ (5), culture room (1),
Plastic houses, gene-flow area,

- Doubled haploid (DH) production in wheat and barley with anther-/isolated microspore culture/crosses with maize or *H. bulbosum*
- *Agrobacterium*-mediated transformation in lentil and chickpeas

Activity per annum:

- Doubled haploid production: in 2005, 2000 DH lines of winter wheat in the field
- Annual capacity: 2000-10.0000
- Crosses for population development (25 per year)
- Development of somaclonal lines in Lathyrus (500 lines per year)
- *Agrobacterium*-mediated transformation in lentil and chickpeas: currently transformation with 5 different constructs (transformation efficiency <1%)

Virology Laboratory

Name of Facility/Laboratory: Centrifuge (one), Ultracentrifuge (one), Eppendorf Centrifuge (one), Density gradient fractionator (one), Spectrophotometer (one), PCR machine (one), Digital image analysis system (computer + monitor screen + Stereomicroscope with video camera), Stereomicroscope with camera (one), Normal stereomicroscope (one), rotary shakers (two), ELISA readers (two), Plant tissue homogenizer (one), Blander (one), Refrigerators (two), Freezers (two), Small incubator (one), Growth-chamber (one), Microwave (one), Stirrers (two), Stirrer with hot plate (one), PH meter (one), Electrophoresis for DNA and Protein (one power supply and two cells), Vortex shakers (two), Balance (one) and Adjustable and fixed-volume pipettes (10 Single and 2 multiple). *In addition, 4 glass house apartments available for the virology research, and rabbit room for antisera production.*

Purpose:

- Identification of viruses affecting legume and cereal crops in CWANA countries.
- Evaluation of faba bean, lentil, chickpea and legume wild relative for resistance to legume viruses.
- Screening cereal breeding lines and cereal wild relatives for resistance to *Barley yellow dwarf virus*.
- Testing for seed-borne viruses (International Nurseries and Gene Bank Accessions)
- Management of legume and cereal viruses.
- Production of antisera and preparation of diagnostic kits for the detection of specific cereal and legume viruses

Senior Scientist: Safaa Kumari

Lab Supervisor (in charge): Safaa Kumari

Names of Other Staff in Lab: Ms Widad Ghulam (Res. Assistant), Ms Nouran Attar (Res. Technician), Mr Mohamed Khalaf (Consultant), Mr Adel Al-Ansi (PhD student), Mr Nader Asaad (MSc student), Ms Rana Al-Jalad (MSc student)

Summary of Tests/Facilities Available: Serological tests (such as ELISA, TBIA), molecular characterizations (such as Electrophoresis for virus coat protein, PCR for virus nucleic acid), purify viruses to produce polyclonal antibodies.

Activity per annum: Some idea of activity/volume of through-put/usage

- ***Identification of Plant Pathogenic Viruses & Development of Diagnostic Kits –*** Since its establishment, the Virology Lab at ICARDA conducted in collaboration with NARS scientists, intensive surveys to identify the virus diseases affecting cereal and legume crops in CWANA countries. During such endeavour, it was clear that the bottleneck for conducting virus surveys in the region is the lack of reliable diagnostic reagents to use in such surveys. Accordingly, for the last 15 years the Virology Lab at ICARDA prepared diagnostic kits for the detection 15 legume viruses and four cereal viruses. Those kits were made available to all Virology Labs in the region, free of charge, to be used for monitoring virus spread in crops as well as for testing for seed-borne viruses. In addition, the Virology Lab at ICARDA receives routinely, blotted membranes from different CWANA countries for processing by TBIA test.
- ***Monitoring*** ICARDA's incoming and outgoing seed shipments to reduce the risk of spreading seed-borne viruses. The Laboratory is also involved in a long-term activity to assure that all germplasm accessions in ICARDA's Gene Bank are free from seed-borne viruses

- Virology Lab staff interacted closely with breeders **to *identify sources of resistance*** to the economically important viruses which affect cereal and legume crops in CWANA. Barley and wheat genotypes resistant to *Barley yellow dwarf virus* were identified. In addition, faba bean genotypes resistant to *Bean yellow mosaic* and *Bean leaf roll viruses*, and lentil genotypes resistant to three different viruses were identified.
- ***Training*** is an important component of the Virology Lab, where research staff from NARS gets acquainted with the most recent techniques in virus detection. Long-term graduate training is also provided. Since its establishment, the Virology Lab provided guidance for 12 students who completed their MSc thesis research and 3 students who completed their PhD thesis research. The Virology Lab over the last decade increased significantly the knowledge base on virus diseases of cereals and legumes through 150 Research papers published in International or Regional Journals, Conference Proceedings and Specialized Books.

Water Laboratory

Purpose:
The Mega project 1 (MP1), Management of Scarce Water Resources and Mitigation of Drought in Dry Areas, at ICARDA conducts extensive water related field and laboratory experiments. MP1 uses, shares, and maintains a wide range of soil, crop, hydraulic, hydrology, and other electronic sensors and measurement devices that are stored, calibrated, and repaired in the Water lab (Figure 1 shows technician setting up a leaf water potential and a datalogger in the lab).

Senior Scientist: Hamid Farahani

Lab Supervisor (in charge): Pierre Hayek (lab attendant to be hired)

Names of Other Staff in Lab:
All MP1 scientists, research associates and students, including engineers and technicians

Summary of Tests/Facilities Available:
MP1 uses lab resources across the campus with Water lab being its main laboratory. For purposes of storage, additional indoor/outdoor space is available on campus for storing large equipment that can not be accommodated in the Water lab. MP1 utilizes and shares its laboratory to support research activities related to measurements of soil water flow and potential, plant water stress and status (porometry, leaf water potential, infrared thermometry), open/closed conduit flow and pressure, water level and well tests, water harvesting, soil profile sampling, runoff/sedimentation, plant growth and biomass, climate variables (temperature, humidity, net/solar radiation, wind speed/direction, rainfall), irrigation (surface, sprinkler, drip), and soil and water quality.

Activity per annum: Some idea of activity/volume of through-put/usage
On yearly basis, extensive laboratory analyses are conducted in support of field activities at Tel Hadya and other research across CWANA. For instance at Tel Hadya alone, the lab supports more that 100 replicated plots of alternate summer crops of maize and cotton, wheat, shrubs and fruit trees under deficit and supplemental irrigation, water harvesting, and marginal water quality research experiments expanding over a few hectares of land.