Annual Report

YEAR 2001

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INTERNATIONAL CENTER FOR BIOSALINE AGRICULTURE
**Mission**

The ICBA mission is to demonstrate the value of saline water resources for the production of environmentally and economically useful plants and to transfer the results to national research services and communities in the Islamic World and elsewhere.

**Mandate**

The ICBA mandate is to develop sustainable management systems to irrigate food and forage crops and ornamental plants with saline water and to provide a resource of salt-tolerant plants for socio-economic development in arid and semi-arid areas and salt-affected areas of the Islamic World and elsewhere.
The International Center for Biosaline Agriculture (ICBA) is an applied research and development (R & D) Center located in Dubai, United Arab Emirates (UAE). The Center was established with financial support from the Islamic Development Bank (IDB) and additional support from the Organization of Petroleum Exporting Countries (OPEC) Fund for International Development, the Arab Fund for Economic and Social Development (AFESD), the Dubai Municipality and the Government of the United Arab Emirates. The construction of the facilities commenced in 1997 and was completed in 1999. The Center began operations in September 1999. ICBA's objective is to develop and promote the use of sustainable agricultural systems that use saline water to grow forages, field crops, vegetables, fruits and trees. The Center does not intend to duplicate work already done by scientific institutes in salinity research, but will act as a focal point for technology development and genetic resource exchange for geographical areas facing problems of salinity and depletion of scarce fresh water. It is expected that the technologies the Center develops will be of global value and will help farmers facing problems of saline soils or salt-water irrigation to improve their production of food and feed in a sustainable manner.

ICBA is initially focusing on problems faced by countries of the Gulf Cooperation Council, followed by other Islamic countries as well as other parts of the world grappling with increasing saline conditions.

The Center is unique in having modern, sophisticated facilities dedicated solely to the development of saline agriculture. It has also recruited renowned scientists working in various disciplines of saline agriculture to implement its R & D Program. The Center is mobilizing its resources to become a 'center of excellence' in the field of biosaline agriculture and intends to serve its clientele across the world.
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Meeting water demand for human activities and ecosystems with dwindling freshwater resources is becoming increasingly challenging in many IDB-member countries, most especially in semi-arid and arid regions, where 80-90 percent of water is used for irrigated agriculture and livestock production. These countries are entering a "vicious circle" in which lack of water is constraining economic growth and development that will, in turn, limit investment in new water supplies and conservation. Consequently, the need to increase agricultural productivity per unit of water has never been so critical to improving the lives of millions of people, especially the poor, throughout the member countries.

This worrisome situation coupled with the rising problem of salinity, which according to the latest reports affects, in varying degrees, nearly half of the world’s total irrigated area, led IDB, in partnership with the UAE Government, and with the support of the Arab Fund for Economic and Social Development and the OPEC Fund for International Development, to launch the International Center for Biosaline Agriculture (ICBA) to harness the vast saline water resources available in many member countries.

ICBA’s noble mission is greatly challenging. Indeed, to fulfill it, ICBA must work hand in hand with the concerned partners in member countries, who, in turn, should fully support it and help shape its programs and activities in order to make them responsive to their needs and concerns. ICBA’s long-term achievements and sustainability will largely depend on this.

I firmly believe that ICBA with the support of all its partners, will continue to have an effective role in the on-going quest for solutions to better manage water resources in member countries, in order to satisfy domestic, agricultural, industrial and ecological water requirements.

Consequently, I wish to invite all concerned policy- and decision-makers in the member countries to extend support to this promising institution to enable it to achieve its noble objectives.

In conclusion, I wish to reiterate, on behalf of the ICBA Board of Trustees, our most sincere thanks to the host country, the United Arab Emirates, for the continuous support being provided to ICBA. Similarly, I wish to express our most sincere gratitude to both the Arab Fund and the OPEC Fund for their unequivocal support to ICBA’s on-going activities.

Dr Ahmad Mohamed Ali
President, Islamic Development Bank,
and Chairman, ICBA Board of Trustees
This Annual Report records ICBA's second year of operations. This report confirms that ICBA is on course to play a pivotal role in promoting biosaline agriculture globally, thanks to continued support from our founding donor, the Islamic Development Bank, and its member countries, as well as regional and international donors.

Although it is often stated that reducing poverty, increasing food production and protecting natural resources are long-term endeavors, centers such as ICBA are challenged to solve immediate problems and develop technologies with a short-term payoff. Thus, in tackling the challenges of biosaline agriculture, ICBA utilizes a mix of strategies to address both present and future needs for sustainable agricultural production systems using saline water or in lands affected by salinity.


- ICBA collaborated with leading international and national research and development organizations, to test and evaluate salt-tolerant crops and forages, and halophytes. Recommendations for selection for further evaluation were made based on tests of over 70 salt-tolerant plants in the field.
- ICBA held training courses and workshops on biosaline agriculture. Over 100 technical staff from Gulf Cooperation Council (GCC) countries, the Middle East, Africa, and West Asia participated.
- In March 2001, ICBA convened the "First International Symposium on Biosaline Agriculture in Gulf Cooperation Council countries" in Dubai, United Arab Emirates. The 3-day event attracted 160 participants from 26 countries and fostered consensus on priority actions to advance biosaline agriculture.
- ICBA forged important links with future collaborators at the national, regional and international levels. Six Memoranda of Understanding were signed in 2001.
- ICBA was recognized as a partner of the Consultative Group on International Agricultural Research (CGIAR); as an Associate Member of the Asia Pacific Association of Agricultural Research Institutions (APAARI); and as a Consulting Partner of the Global Water Partnership (GWP).
- ICBA successfully secured grants and contractual work from international donors and from both the private and public sectors.

With continuing support, the Center, through its mandate of promoting biosaline agriculture, will contribute significantly to increasing agricultural productivity as well as to improving livelihoods in many poor countries. I would like to take this opportunity to express thanks and appreciation to the host country, the United Arab Emirates, for all the help, support and encouragement it provides to ICBA. The cooperation received from all relevant agencies and organizations in the UAE is exemplary in all respects. I am confident it will continue for many years to come.

Dr. Mohammad Al-Attar
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Board of Directors

The governance and policies of the International Center for Biosaline Agriculture are in the hands of the Center's Board of Directors, a nine-member committee appointed by the Islamic Development Bank and the Center's host country, UAE. ICBA's Director General, Dr. Mohammad H. Al-Attar, chairs the Board of Directors. The Board of Directors is responsible to the Board of Trustees, which is chaired by the IDB President, Dr. Ahmad Mohamed Ali.

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Technical Programs

HIGHLIGHTS

In 2001, its second year of operations, ICBA's core projects continued as planned and several others were added to meet the Center's mandate and mission. These projects were progressing well as ICBA staff continued to validate the salt-tolerance of germplasm acquired and establish their role within a sustainable production management system. Further seed samples of salt-tolerant materials were acquired and the genebank swelled to over 6,000 accessions.

A collaborative project with the Environmental Research and Wildlife Development Agency (ERWDA) on mangroves in the UAE commenced in 2001. A date palm project involving 10 elite cultivars began at ICBA in collaboration with the Ministry of Agriculture and Fisheries (MAF), UAE. Eight ICRISAT pearl millet genotype and six sorghum varieties from Oman showed outstanding growth under saline irrigation at ICBA. Details of these collaborative activities follow.

ICBA made several important formal links with its future collaborators, at the national, regional and international levels. Memoranda of Understanding (MoUs) were signed with:

* Environmental Research and Wildlife Development Agency (ERWDA), UAE
* King Abdulaziz City for Science and Technology (KACST), Kingdom of Saudi Arabia
* Ministry of Agriculture, Animal Wealth and Irrigation, State of Khartoum, Sudan
* Arab Authority for Agricultural Investment and Development (AAAID), Khartoum, Sudan
* Arab Organization for Agricultural Development (AOAD), Khartoum, Sudan
* International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India

ICBA was inducted as an associate member of the Asia Pacific Association of Agricultural Research Institutions (APAARI) and as a consulting partner of the Global Water Partnership (GWP).

ICBA successfully organized an international symposium on "Prospects of Saline Agriculture in the Gulf Cooperation Council (GCC) Countries" in March. Three international training courses were held at ICBA, primarily benefiting the GCC countries.

A proposal seeking support for training and networking activities for $200,000 over two years at ICBA was submitted to...
the OPEC Fund for International Development. Although the funds were not received during the calendar year, the grant was approved by the donor toward the end of 2001, and the activities were set to commence in 2002. The Ruler’s Court of Dubai decided to waive the cost of water used by the Center for its research and development activities. ICBA prepared its Resource Mobilization Plan 2000 - 2009, which was presented to its major founding donor, the Islamic Development Bank.

Several publications were produced. These included the first ICBA Annual Report 2000, ICBA Strategic Plan 2000-2004 and two issues of the Center’s newsletter, Biosalinity News. Additionally ICBA staff presented/published 15 papers at regional and international scientific meetings.

**INTRODUCTION**

ICBA focuses on strategic, applied, and adaptive research. Strategic research aims to produce a better understanding of the processes related to regionally and internationally significant problems of using saline water in agricultural production and greening. ICBA’s applied research employs existing knowledge and innovative technology to solve problems of widespread importance in saline irrigated agriculture. ICBA’s adaptive research aims to interpret the problems of its partners and beneficiaries, identify appropriate solutions and relevant prototype technologies, and fit these to the particular circumstances of the partner or beneficiary.

The implementation of such research activities at the regional level and across a broad spectrum of biosalinity-related issues poses major challenges. It is often difficult to reconcile the location-specific focus of our partners with ICBA’s emphasis on international public goods research. Effective research partnerships are the principal means through which ICBA’s outputs of strategic research will be locally adapted and evaluated.

**ICBA’s Research Programs**

Broadly, ICBA’s research structure consists of four technical programs:

- Plant genetic resources
- Production and management systems
- Communication, information management and networking
- Training, workshops and conferences

Within each of these programs, ICBA’s work program is organized through a series of projects and activities, each with clearly defined problems (research) or needs (communication, information, networking, training and workshops) that are addressed, and with potential outcome(s).
**Objective**

Promote agricultural production, environmental greening and revegetation under saline conditions by introducing, selecting, storing, and distributing potentially salt-tolerant plants, including halophytes.

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**CORE PROJECTS**

**Acquisition, Collection and Conservation**

ICBA continued to acquire new species and accessions from different sources (Australia, Germany, ICARDA, ICRISAT, Oman, UAE and USA) of salt-tolerant and potentially salt-tolerant germplasm. At the end of year 2001, the total number of accessions available in ICBA’s genebank reached more than 6600. The accessions represent 200 species, which belong to 63 genera and 16 families. The germplasm mainly comprises forage grasses (43.1%) and forage legumes (39.5%). Forage shrubs of the Chenopodiaceae family represent 3.2%, and the remaining 14.2% is made up of the other thirteen families.

The ICBA germplasm collection (Appendix 1) originated from 80 countries spread over all the continents. However, a sizable part of the collection (30%) had its origins in West Asian and North African countries.

**Seed Increase of Salt-tolerant Germplasm**

**In the Laboratory**

**Screening for salinity tolerance at the germination stage.** For plant species with a large number of accessions, a procedure of screening for salinity tolerance at the germination stage was adapted to narrow down the number of accessions that will be evaluated on a wider field or controlled scale. The following species and number of accessions/species were screened for salinity tolerance at 20 dS m⁻¹:

- Sorghum (302 accessions)
- Safflower (640 accessions)
- Triticosecale (500 accessions).
As many as 70 representative accessions of seven clusters of the Omani landrace barley were screened at 30 ds m\(^{-1}\) for salt tolerance.

The same 70 accessions of Omani landrace barley were evaluated for their protein and lysine content; their genetic diversity was also assessed based on allelic variability at eight isozyme loci. This part of the evaluation was carried out in cooperation with Yarmouk University, Jordan.

In the Field

Several species from the materials acquired in ICBA's genebank were selected as priority species for seed increase to be used in subsequent salinity tolerance evaluation procedures. Field seed increase will also serve in assessing growth potential and general adaptation to the local environmental conditions. This will facilitate the selection of accessions that will be used in field evaluation. The following species/accessions were planted for seed increase:

*Centochrus ciliaris* (822 accessions): Ten single seedlings per accession were planted in the field. However, as a warm-season forage grass, establishment, growth and development of the plants were not satisfactory for most part of the winter season. Some 500 accessions of the species were able to set seed in the field, but most seeds were small and light in weight due to the prevailing harsh environmental conditions. Seed viability will be tested to ensure that only viable seed will be stored in the cold storage rooms and provided to ICBA scientists for field planting.

Some 300 accessions that either did not grow well or did not produce seed in the field were transplanted into pots in the greenhouse. Earlier in a preliminary experiment, some *C. ciliaris* accessions were successfully grown in the greenhouse and these produced large amounts of viable seed. The same procedure will be applied to alfalfa germplasm. Seeds of some accessions were collected both from the field and the greenhouse experiments. The seed production of *C. ciliaris* was very poor in the field while the accessions grown in the greenhouse produced a good quantity and quality of seed.

All accessions were replanted during the fall in a well-prepared field. All have been successfully established and showed excellent growth under local environmental conditions.
Omani landrace barley (1000 single-spike selections): The selections, representing seven unique clusters of Omani landrace barley, were planted in the field for seed multiplication and evaluation of their morphological traits. Collected information was preserved in a database. After successful germination (~89%), only a small fraction of the plants (~5%) set seed. This was due to many interacting factors including soil spatial variability and lack of uniform spatio-temporal water application.

These problems were corrected and a new field was developed with the proper irrigation and fertilizer input. In November, 2080 accessions of Omani barley lines and improved barley lines from ICARDA’s breeding program were planted in the new field. All lines were fully established and showed extremely good growth given the harsh environmental conditions in the region. This work is expected to lead to the identification of barley lines with good adaptation to harsh hot-dry environments and with favorable production traits.

Sorghum bicolor (302 accessions): Seeds were directly sown in the field; germination and seedling development were weak due to the same reasons mentioned above. Accessions that showed better germination under high levels of salinity were replanted during fall 2001 for seed increase.

Forage species (474 accessions): Medicago sativa (the top 193 salt-tolerant accessions), pearl millet (22 accessions), and Lathyrus sp. (259 accessions) were grown at ICBA. Low temperatures during winter delayed germination and development of most accessions. Planting will be redone during early spring in 2002.

Carthamus tinctorius (640 accessions): The oil-crop commonly known as safflower is a potential forage crop under the right soil and climatic conditions. These accessions will be evaluated for both seed and biomass production under the prevailing environmental conditions at ICBA station.
* Determine the appropriate fertilizer regime for maximum production.
* Assess the nutritional value of the two species in response to the different salinity, irrigation and fertilizer levels.

Applications of the different management inputs are currently underway. Valuable results are expected to be generated from this project on the economic feasibility and sustainability of forage production systems that are based on the use of non-conventional salt-tolerant grasses.

**Optimizing management practices for maximum production of three Atriplex species (A. halimus, A. nummularia, A. lentiformis) under high salinity levels**

Nearly 5000 cuttings from the three species of Atriplex (saltbush) were produced during July. Between October and December, a 1.5-hectare research and demonstration field was established. Three factorial experiments were implemented, one for each species. Several production factors were used, including: three salinity levels (10, 20 and 30 dS m$^{-1}$), three irrigation levels ($ET_{0}$, $1.5 \times ET_{0}$ and $2 \times ET_{0}$), three population densities (2 x 2 m, 2 x 1.5 m and 2 x 1 m) and six different fertilizer treatments to determine the four objectives similar to those of the two salt-tolerant grasses/studies and additionally to determine the optimum plant density for maximum production under all salinity levels applied.

All treatments are currently underway. Similar to the grass research, this project is expected to yield valuable information and scientific evidence on the productivity potential, feasibility and long-term sustainability of forage production systems that are based on the use of salt-tolerant forage shrubs. The grass and shrub systems are viewed to complement each other in providing forage materials for livestock.
Field and Forage Crops

Objective
Evaluate and select new and improved varieties of field and forage crops and investigate improved management techniques for their ability to sustain economic production under irrigation with moderately to highly saline water.

CORE PROJECTS

Optimizing management practices for maximum production of two salt-tolerant grasses: Sporobolus virginicus and Distichlis spicata

More than 70,000 seedlings of each of the two grass species were produced by vegetative propagation for establishing large-scale research and demonstration fields. Two factorial experiments were implemented in the field during October-December, on about 6000 m², to evaluate the effects of several management inputs on the productivity of the two salt-tolerant grasses and for long-term monitoring of the biosaline agriculture system. Three salinity levels (10, 20 and 30 dS m⁻¹), three irrigation levels (ET₀, 1.5 × ET₀ and 2 × ET₀) and four fertilizer treatments of NPK (0, 40, 80 and 120 kg ha⁻¹) were used to:

* Determine yield potentials of the two grasses when grown under high salinity levels, and the level at which the productivity remains economical.
* Determine the optimal irrigation level for maximum production of the two grasses and the level that minimizes salt accumulation in the soil.
COLLABORATIVE PROJECTS

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) Collaboration

Objectives

- Evaluate yield potential (seed and total biomass production) of 42 pearl millet varieties grown under local environmental conditions and three salinity levels (5, 10, and 15 dS m⁻¹).
- Compare the response of the same set of genotypes to salinity during fall (October-November) and spring (March-April) planting.
- Select genotypes that are suitable to fall, spring or both planting seasons.
- Select the most promising accessions for forage or seed production or dual purpose for further evaluation.
- Compare the chemical composition of selected high and low yielding genotypes.
- Produce sufficient seed for further research and testing at selected national agricultural research systems in the region.

Evaluation of salinity tolerance, growth, yield potential and forage quality of 42 cultivars of pearl millet (Pennisetum glaucum) under field conditions

Based on previous promising results of the evaluation of several pearl millet genotypes, 42 new elite genotypes were acquired from ICRISAT through the collaborative research program with ICBA. They are being evaluated for salinity tolerance and general adaptation to the regional environmental conditions, with the ultimate objective of selecting salt-tolerant genotypes that are suitable for forage production and for dual purpose of seed and biomass production.

The fall experiment was planted in October. ICBA scientists will plant the same experiment in March 2002, and thus be able to compare results of both planting times and select pearl millet genotypes that are salt-tolerant and suitable for winter and/or summer growth.

Screening for salinity tolerance among selected pearl millet accessions

In addition to the elite varieties mentioned above, 48 pearl millet genotypes from ICRISAT’s core collection that represent a wide range in the genetic diversity for biomass and seed production, were also acquired by ICBA.
**Objectives**

- Evaluate yield potential (seed and total biomass production) of 48 pearl millet accessions from ICRISAT’s core collection under UAE environmental conditions.
- Evaluate salinity tolerance of pearl millet accessions under medium and high levels (10 and 15 dS m⁻¹).
- Compare the response of the same set of genotypes to salinity during fall (October-November) and spring (March-April) planting.
- Select the most promising accessions for forage or seed production or dual purpose for further evaluation.

The experiment was planted in October and is expected to last 4 months. Initial observations indicated that there are wide variations in biomass and seed production among the genotypes and that there is a good potential for selecting genotypes with high production under high salinity levels.

The same experiment will be planted during March 2002. This will enable ICBA scientists to compare results of the fall and spring plantings and select pearl millet genotypes that are salt tolerant and suitable for winter and/or summer growth.

**Screening for salinity tolerance among selected sorghum accessions**

**Objective**

The objectives of the screening of 87 sorghum genotypes are identical to those screening studies involving 48 pearl millet genotypes mentioned earlier.

Similarly, 87 genotypes of sorghum were obtained from ICRISAT’s core collection. They possess a wide range in production and growth traits. They are being evaluated for growth potential and salinity tolerance in fall and spring planting.
The experiment was planted in October and expected to last 4 months. Preliminary observations showed that a few of the sorghum genotypes evaluated have potential for growth and salinity tolerance under the relatively low temperature conditions during the mild winters of the region.

The same experiment, along with other newly acquired materials, will be planted during March 2002. As with earlier-mentioned studies, ICBA scientists will be able to compare results of both planting times and select sorghum genotypes that are salt tolerant and suitable for winter and summer growth conditions of the region.

**UAE Ministry of Agriculture and Fisheries (MAF) Collaboration**

**Investigation of ten elite UAE date palm varieties for salt tolerance**

**Objective**

*Study the long-term effects of salinity on the fruit quality and quantity of the ten best date palm varieties in the UAE.*

Ten most preferred date palm varieties (Khalas, Faradh, Barhi, Lulu, Djibri, Naghal, Khasab, Khanizi, Shahle and Abu Maan) in the UAE were selected in collaboration with the UAE MAF.

The ten varieties were planted during May/June in a replicated field experiment under three salinity levels and five replications of each variety for a total of 150 trees. By the end of 2001, most of the date-palm trees survived the summer and showed signs of new growth. Up to 29 trees did not show satisfactorily establishment and initial growth. They will be replaced with saplings of the same age and growth status during 2002. Irrigation at three salinity levels (5, 10 and 15 dS m$^{-1}$) will be applied at the end of the replacement stage.
UAE University Collaboration (M.Sc. student's thesis research project)

Objectives

- Compare salinity tolerance among different cultivars of Rhodes grass (Chloris gayana cvs. Pioneer, Callide and Katambora) and Panicum grass (Panicum maximum cvs. Green and Gatton).
- Evaluate the nutritional value of the different species/varieties in response to different salinity levels.
- Evaluate water use efficiency (WUE) of the different species/varieties in response to two moisture levels.

Effects of irrigation water salinity on growth and forage quality of some salt-tolerant species under UAE conditions

Rhodes grass (Chloris gayana) is considered to be the best irrigated forage grass with the largest cultivated area and highest productivity in the UAE in particular and in the GCC countries in general. Although it is very well adapted to hot environments, the high water demands of the crop and the increasing salinization of underground water are becoming important issues in determining the future potential of the crop in the region. Variations under farmers' field conditions in salinity tolerance were observed among several Rhodes and Panicum grass varieties commercially available in the region. Such variations among cultivars in response to salinity and in water use efficiency have not been systematically evaluated.

The experiment was established in May. Three salinity levels (5, 10 and 15 dS m$^{-1}$) and two moisture levels ($E_{T0}$ and 1.3 $E_{T0}$) were applied. Periodical observations and measurements of growth and other parameters are underway. Data analysis and a summary of results will be completed during 2002.
OTHER RESEARCH RELATED ACTIVITIES

Mass production of two salt-tolerant grasses: Sporobolus virginicus and Distichlis spicata

The two species were targeted by ICBA among the prime salt-tolerant forage grasses. In order to generate sufficient plant materials for large-scale research and demonstration plots, a few hundred plants of the two species were established from seeds and cuttings. Consequently, the plants were used to establish mother fields of the two species during the first quarter of 2001. A few months later mother fields reached full coverage and mass production of transplants started in July. By November over 70,000 plants of each species were produced and used in the establishment of the two research and demonstration plots.

Clockwise from top left: Stages in the establishment of a large-scale research and demonstration field
Mass production of three Atriplex species: A. halimus, A. lentiformis and A. nummularia

Similar to the procedure used for the grasses, mother fields of three Atriplex species were established in March. Mass production of nearly 5000 plants of the three species started in July. The plants were allowed to grow for three months prior to transferring them to a 1.6 ha permanent research and demonstration field.

Field evaluation and seed production of eight selected pearl millet and sorghum genotypes

Eight pearl millet genotypes, from ICRISAT’s breeding program, and six sorghum varieties from Oman were planted in mid-March for seed production under local environmental conditions. Both growth and seed production were outstanding in all varieties studied. Based on these initial results, larger scale field experiments were planned and conducted at a later stage under different salinity levels. (See Collaborative Projects, page 23).
Halophyte Production

**Halophytes**
Early farmers and pastoralists recognized the high fodder quality, high water-use efficiency, and deferred production of certain halophyte species. Recently, halophytes have been incorporated in pasture-improvement programs in many salt-affected regions of the world.

Halophytes are an untapped genetic resource that could be used to develop crops that can be grown in saline environments. These wild plants, if domesticated, can utilize saline water and soil resources for agricultural production. Their seeds, fruits, roots, tubers, or foliage can be used directly or indirectly as food. Some seed-bearing halophytes are potential sources of grain and oil.

**Objective**
To evaluate and select new and improved varieties of halophytes for agricultural production and greening projects. Plants selected will persist and produce at salinities of 15,000 ppm (21.5 dS m$^{-1}$) and greater.

**CORE PROJECTS**

**Mass Screening of Halophytes**
Selection of germplasm is the first step towards proper identification and propagation of plant material for productivity management. Though a number of genera and species are known or found to be salt tolerant, with high productivity and

**Objectives**
- Rapid screening of halophytic and salt-tolerant germplasm for greenhouse and field trials.
- Identification of germplasm with desirable characteristics for field experiments.
good nutritional (for forage) and wood (for timber) value. The suitability of the seeds always depends upon the genetic source(s) and the prevailing edaphic and climatic conditions. Some species are also known to be physiologically adapted to saline conditions. Consequently progenies produced through seeds do not exhibit salt-tolerance traits and fail to germinate and grow under saline conditions. In many cases, species, species and genotype/ecotype have been known to show entirely different responses. Different accessions of a single species grown exhibit different responses within different geographical boundaries.

A glasshouse hydroponics system was designed and set up in ICBA to rapidly screen germplasm collected from different parts of the world.

The screening set-up was constructed using a locally fabricated hydroponics system to rapidly and reliably evaluate the salt-tolerance of plant species. The system utilizes 10 cm diameter plastic pots filled with gravel. The pots have a drainage outlet at the bottom. Water application is controlled through a timer and the drainage water for each salinity treatment (3-40 dS m⁻¹), prepared in 1/4th Hoagland solution, is collected and re-circulated to the saline water tank and re-used for irrigation.

This report summarizes the results of 24 different accessions of Triticosecale and 36 of Melilotus officinalis.

**Triticosecale (Triticale) accessions.** Different accessions of Triticosecale were fully exposed to the different salinity levels over four weeks response differently. Accessions #29185 and #20123 exhibited 100% survival at all salinity levels, whereas accessions #429227 and 508249 exhibited 100% survival at 12 and 15 dS m⁻¹. This was due to low germination in some of the replicates rather than the effect of salts during the growth stage. Accessions #429206 and #429290 showed poor germination and survival. Not only did the accessions show differences in growth due to salinity, but they also exhibited different in spike formation.

Growth of plants also exhibited similar response to that of survival of plants. Those which showed better survival also showed better plant height (she
and root length) and increased number of leaves. Accession # 429185 showed
maximum shoot length and was not affected by salinity treatments followed by
accessions #429227, 520123 and 429231. Root length for most of the accessions
studied did not vary significantly with different salinity levels. Maximum root
length was observed in accessions # 429303, 491409 and 445679. As expected,
the root length for some of the accessions did not show a strong relationship to
the shoot length; however, the root-shoot relationship appears to be associated
with biomass rather than length.

Higher fresh and dry weight of shoots was observed in accession # 429227
(which exhibited higher survival and better plant height) followed by 429194
and 429231. Maximum fresh and dry weight was observed at different salt levels followed by a reduction.

Accessions 429227 and 520123 showed non-significant differences among all the salt levels and had
better response even at 15 dS m⁻¹. A reduction in weight after 3 dS m⁻¹ was evident in accessions #
429194 and 429231; after 6 dS m⁻¹ in Acc. # 429185, 429215 and 429303; after 9 dS m⁻¹ in accessions #
491409 and 508249.

Root weight showed a different trend among the accessions as compared to shoot weight but appears
to be related to the translocation of metabolites from root to shoot and vice versa depending upon the
stage of growth (vegetative or reproductive). Accessions # 429185 and 520123, which exhibited a higher
survival percentage and plant height, did not exhibit higher vegetative biomass, though exhibiting
higher tolerance to salt.

*Melilotus officinalis* accessions. When grown under non-saline conditions, the seeds of *M. officinalis*
showed poor viability. Hence, later on, both survival and growth exhibited discrete growth patterns at
different salinity levels.

Accessions such as AMLS 19261 are reported to be highly salt tolerant and hence 40% survival was
evident under salinity up to 40 dS m⁻¹, even though some of the replicates in other salinity treatments
failed to germinate and survive. In addition, accessions # PI 342804 and 342720 also survived at 40 dS
m⁻¹, but these accessions exhibited very poor germination for the rest of the salt treatments. On the
other hand, accessions # 213328, # 230531 and # 314719, survived most salinity treatments, though the
percentage germination remained very low. However, in spite of some very high germination values, no
definite conclusion can be drawn for *M. officinalis* accessions due to significant absence of replicates for
other salt treatments. It is necessary to try the same lot of accessions again with a higher percentage of
germination to obtain meaningful conclusions.
**Water use and salt balance in halophytes**

Soil salinity build-up occurs as a result of imbalance between irrigation and crop evapo-transpiration rates, when water is removed from the soil surface at higher rates than is added, leaving behind the salts. Management of soil salinity requires a good knowledge of the water requirement of a particular species to optimize the irrigation amount and frequency. As a result, water needs to be moved beyond the root zone of a species, pushing the salts deeper in the soil profile. However, in spite of irrigation scheduling, many other factors, such as temperature, humidity, soil texture and water salinity cause the daily evapo-transpiration rates to fluctuate and as a result, upward salt movement takes place, affecting plant growth.

Salt-water balance can be calculated using modeling techniques. However, it is important to find the relationship of water quality and quantity on soil salinity and yield parameters.

The experiment was conducted using drainage lysimeters with six-week old seedlings of *Salvadora persica* transplanted in each lysimeter and irrigated with 8 different levels of salinity (5-40 dS m\(^{-1}\)). Two different irrigation levels of 1.0 and 1.5 times the water requirement were applied for each salinity treatment, with three replicates. Water was supplied using a drip irrigation system connected to a variable salinity source. The volume of the drained water was measured after irrigation to determine the water use of plants.

The growth of *S. persica* plants was monitored at different stages. Different levels of irrigation at 1 and 1.5 times the water requirement did not have any significant effect on plant height and plants showed more-or-less similar heights under all treatments, with a slight reduction from 35 dS m\(^{-1}\).
Measurements of drained water showed a higher volume of water irrespective of salinity treatments during low temperature periods, owing to low evapo-transpiration rates.

Relative growth rates of plants for different treatments, and salt-water balance based on salt content in soil, plant parts and drainage water will be calculated after one year of growth.
COLLABORATIVE PROJECTS

International Atomic Energy Agency (IAEA) and Ministry of Agriculture and Fisheries (MAF) Collaboration

Sustainable utilization of saline groundwater and wastelands for plant production

Objectives

- Demonstrate on a pilot scale and study the utilization of salt-affected lands and different water quality (fresh or saline) for growing salt-tolerant plant species (grasses, shrubs and trees).
- Demonstrate the favorable effects of plant growth on soil fertility and productivity.

In 1995, an IAEA and Ministry of Agriculture and Fisheries, UAE, concept paper on 'Economic utilization of salt-affected land and saline groundwater to grow salt-tolerant plant species' led to the approval and execution of a six-year project in different countries across the region, including Morocco, Tunisia, Egypt, Syria, Iran and Pakistan. The project, apart from introducing and demonstrating salt-tolerant plants, will study the management of irrigation water, monitor groundwater dynamics and transfer technology to end users.

In 2000, ICBA was invited to join the project through the UAE Ministry of Agriculture and Fisheries. ICBA therefore, joined the team in 2000 as part of the second phase of the IAEA project.

Seeds of different species/accessions were obtained from different sources for the demonstration trials (Table 1). Different species were grown at different times as and when the seeds were available.

<table>
<thead>
<tr>
<th>Plant species</th>
<th>Growth stage</th>
<th>Seed source</th>
<th>Date of planting</th>
<th>Plot size (m)</th>
<th>Inter-plant distance (m)</th>
<th>Salinity of water (dS m⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atriplex lentiformis</td>
<td>Seeds</td>
<td>USDA Acc#FSD-89 F1</td>
<td>Nov.2000</td>
<td>24 x 24</td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>A. canescens</td>
<td>Seeds</td>
<td>USDA Acc#FSD-99 F1</td>
<td>Nov.2000</td>
<td>24 x 24</td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>A. undulata</td>
<td>Seedlings</td>
<td>Dept. of Agric WA</td>
<td>Mar.2001</td>
<td>24 x 24</td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>A. nummularia</td>
<td>Seedlings</td>
<td>Dept. of Agric WA</td>
<td>Mar.2001</td>
<td>24 x 24</td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>Leucaena leucocephala</td>
<td>Seedlings</td>
<td>Pakistan</td>
<td>Nov.2000</td>
<td>24 x 24</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>Salvadoria persica</td>
<td>Seedlings</td>
<td>Local (UAE)</td>
<td>Nov.2000</td>
<td>24 x 24</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>Sesbania aculeata</td>
<td>Seedlings</td>
<td>IAEA</td>
<td>Apr.2001</td>
<td>15 x15</td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>Kochia Indica</td>
<td>Seedlings</td>
<td>IAEA</td>
<td>Apr.2001</td>
<td>15 x15</td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>Acacia nilotica</td>
<td>Seedlings</td>
<td>IAEA</td>
<td>Apr.2001</td>
<td>15 x15</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>A. amplusps</td>
<td>Seedlings</td>
<td>IAEA</td>
<td>Apr.2001</td>
<td>15 x15</td>
<td>3</td>
<td>25</td>
</tr>
</tbody>
</table>

(Table 1. Description of plant species and experimental set-up. (All species were irrigated by drip irrigation @ 3.8 l/hour for one hour per day))
Growth of salt-tolerant plant species

Different species were monitored for their growth parameters. Plant height varied with species and nature of plants. Woody *Atriplex* species reached up to 80-90 cm in 9 weeks whereas, shrubby species like *Atriplex canescens* and *A. undulata* ranged between 60 and 75 cm. The growth rate of all the species was high during the summer (March-June) and minimal during winter.

Shoot volume of the *Atriplex* species, calculated from height and the two right angle diameters of the plants (multiplied with a constant depending on the shape of the plants), exhibited a progressive increase with time. The woody species, namely *A. nummularia* and *A. lentiformis* have a greater plant volume due to their growth habit. However, all the four species more or less show the same growth rate, indicating that their absolute values may be different owing to their habitat, but the rate remains unaffected.

The tree species included some fast growing species such as *Leucaena leucocephala*, *Sesbania aculeata* and *Acacia ampliceps* along with the slow growing *Acacia nilotica*. Though *L. leucocephala* exhibited maximum growth in height, the growth of *A. ampliceps* was significantly better than all the test species overall. Growth of the two *Acacia* species, namely *A. nilotica* and *A. ampliceps*, was also significantly different, though both the species had similar height after 7 months. The annual, *Kochia indica*, also showed a high growth rate even when irrigated with saline water of 25 dS m$^{-1}$. 
Plant training and water management for establishment of windbreak plants in shallow water table areas

**Objectives**

- Replicate the natural conditions that would enable indigenous plants to grow in arid environments with minimal water application.
- Develop a water management scheme that would encourage indigenous plants to tap into shallow water table sources.
- Develop a demonstration pilot project where indigenous plants are growing with no external water application.

Indigenous species of trees and shrubs in the Arabian Peninsula are known for their ability to withstand abiotic stresses such as heat, drought, and salinity, and therefore are the main constituents of any greening project. With an evolved root system and an adequate tolerance to salinity, naturally existing plants in the desert survive on brackish water drawn from shallow aquifers. The purpose of this research is to develop methodologies for conditioning indigenous plants to become more efficient water users, by using less water and water of low quality. In essence, plants are stimulated to develop long roots in the greenhouse. Upon transplanting, the plant that has already an evolved root system is stimulated to develop its roots further using appropriate irrigation management practices.

Several tree species, *Prosopis tamarugo*, *Acacia arabica*, *Leucaena leucocephala* and *Prosopis cineraria* were grown for eight weeks in plastic tubes each having a length of 1.5 m and a diameter of 5 cm. Towards the end of the year 2000, 249 plants were transplanted into the field. In November 2001, 300 additional plants consisting of *Acacia arabica* and *Prosopis cineraria* were transplanted in a repetition of the earlier experiment.

Of the first batch of 249 plants, only 12 plants survived the summer of 2001 although 80% were still alive by June 2001. The reason for this large proportion of mortalities was attributed to the stage of growth of plants upon transplanting. Plants that survived the summer were far more developed at the time of transplanting than other plants. In terms of species, mortalities were largest amongst *Prosopis tamarugo*, which is native to Chile while *Acacia arabica*, which is native to the Arabian Peninsula had the largest number of surviving plants. For this reason the next plot consisted of *Acacia arabica* and *Prosopis cineraria*, another local species. By December 2001, a new batch of 300 deep-rooted plants was transplanted.
International Center for Agricultural Research in the Dry Areas (ICARDA) Collaboration

Evaluation of irrigation practices and fertilizer requirements for optimizing productivity of three indigenous grass species

Objectives

- Evaluate water use efficiency, salinity tolerance, and fertilizer requirements of Coelachyrum piercei, Cenchrus ciliaris, and Chloris gayana.
- Determine the appropriate irrigation system and irrigation management practices for the above species.

Introduction of plant species/varieties/accessions has been one of the major developments that has taken place in modern agriculture. Species developed by conventional and modern biotechnological methods have been evaluated and put under production systems in other parts of the world under comparable environmental conditions. However, in many cases, locally grown species are known to be more salt-tolerant than introduced germplasm of the same species.

From earlier studies, many naturally occurring species have been identified in the Arabian Peninsula region that can tolerate high temperature, drought and salt stresses. Efforts were then made to introduce these species under saline water irrigation. This was followed by analyzing other characteristics such as water use efficiency, seed production, and forage quality.

The Arabian Peninsula Regional Program (APRP) of the International Center for Agricultural Research in the Dry Areas (ICARDA) is studying this aspect of land rehabilitation using such species in collaboration with the national agricultural research systems (NARS) in the region. This trial tested the genetic material under different salinity regimes and rates of water application.

Seeds of Cenchrus ciliaris, Coelachyrum piercei, and Chloris gayana provided by the ICARDA-APRP program were directly seeded in a factorial design experiment. Different plots were assigned for three salinity levels (3,500, 7,000 and 10,500 ppm, corresponding to EC 5, 10 and 15 dS m\(^{-1}\)), three irrigation treatments (100% ET, two treatments for 50% ET with different irrigation frequency) and three levels of nitrogen fertilizer with four replicate sub-plots. All the plots were irrigated with drip irrigation.

Plant harvest was initiated in December to assess the biomass productivity under various levels of treatment. Chloris gayana exhibited higher shoot biomass as compared to other species for all the salinity treatments (Table 2). Moisture percentage in all the test species also varied significantly with salinity treatments and irrigation frequency, ranging from 12-39%.
Table 2. Range of biomass productivities (t ha\(^{-1}\)) of three grass species under three salinity levels. (All data are based on 100% ET irrigation level treatment)

<table>
<thead>
<tr>
<th>Salinity treatment</th>
<th>Weight</th>
<th>Cenchrus ciliaris</th>
<th>Coelachryum piercei</th>
<th>Chioris gayana</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 dS m(^{-1})</td>
<td>Fresh Wt</td>
<td>16.57 - 18.39</td>
<td>12.76 - 16.58</td>
<td>16.56 - 17.51</td>
</tr>
<tr>
<td></td>
<td>Dry Wt</td>
<td>9.48 - 10.96</td>
<td>4.96 - 9.03</td>
<td>10.34 - 12.08</td>
</tr>
<tr>
<td>10 dS m(^{-1})</td>
<td>Fresh Wt</td>
<td>6.16 - 7.10</td>
<td>5.54 - 6.20</td>
<td>5.49 - 7.53</td>
</tr>
<tr>
<td></td>
<td>Dry Wt</td>
<td>4.48 - 5.42</td>
<td>3.66 - 5.06</td>
<td>4.57 - 5.49</td>
</tr>
<tr>
<td>15 dS m(^{-1})</td>
<td>Fresh Wt</td>
<td>5.83 - 7.20</td>
<td>3.95 - 4.72</td>
<td>5.84 - 7.14</td>
</tr>
<tr>
<td></td>
<td>Dry Wt</td>
<td>4.26 - 5.66</td>
<td>2.57 - 4.10</td>
<td>4.38 - 5.73</td>
</tr>
</tbody>
</table>

Soil samples were collected for various treatments at two different depths of 0-75 and 75-150 cm and analyzed for electrical conductivity and pH. After the harvest, EM-38 measurements were taken for soil salinity measurements for individual replicate plants. With soil sampling at different plant points and different treatments, the variation in soil salinity was significantly high. However, in general, soil salinity appeared to be higher in the upper soil profile (0-75 cm) where Chloris gayana were grown. At high salinity water treatments the soil salinity (EC\(_{1.5}\)) showed variation between 2.26 and 7.72 dS m\(^{-1}\).

**SPECIAL PROJECTS**

**Assessment and Management of Saline Process Water for the Nimr Reed Beds**

Petroleum Development Oman (PDO), a private sector company in Oman, is experimenting with new ways for using the saline water produced along with oil. This process water is procured along with oil extracted at a water-oil ratio of 4:1. Initially, this process water was injected in deep aquifers at high pressures and at high cost. Following a meeting with senior staff at ICBA, PDO became interested in using such water for biosaline agriculture with potential economic returns and environmental benefits.
benefits. ICBA was requested by PDO to develop the concept and oversee its implementation.

The first step was to improve the quality of the process water. Collected water samples had noticeable oil content and some heavy metals. Treatment was needed before applying this water to agricultural lands.

PDO developed a biological treatment using a pioneering design of reed beds (*Phragmites australis*). The bacteria on the root system of the reeds digest the oil droplets while negatively charged clay particles of the rhizosphere absorb heavy metals. Water draining from these beds was expected to be more saline but pollutant-free.

For a number of reasons, the reed beds did not function as predicted. Reed plants were not healthy and the drainage water had significant oil content and some residual heavy metals. Following a series of visits to the reed bed site in Nimr, about 700 km south east of Muscat, ICBA scientists performed a thorough evaluation of reed beds from both design and management perspectives. Analyses involved soil, water, and plant samples.

Recommendations from these analyses were presented to senior officials from PDO. The implementation of these recommendations improved the reeds' health. Oil-in-water content of drainage water dropped from over 100 ppm to less than 15 ppm. This drainage water had a salinity of 14.9 dS m⁻¹ and was suitable for use in biosaline agriculture activities.

As a follow up, ICBA was requested to design a new reed bed system that would incorporate all the recommendations of earlier investigations. This design was prepared and the implementation of the project began in December 2001.

ICBA was also requested by PDO to synthesize all beneficial uses of biosaline agriculture projects worldwide and develop a concept design for a 1.5 hectares pilot demonstration site. This pilot project will be irrigated entirely with treated process water.

**Managing Salinity and Waterlogging in Abu Dhabi Farms**

Several coastal agricultural areas in the Emirate of Abu Dhabi are covered with a clayey soil layer with low permeability. External additions of irrigation waters have caused waterlogging and soil salinity problems
on farms located in natural depressions. The evaporation of stagnant water containing dissolved salts causes soil salinity in such areas.

The Sewerage Projects Committee (SPC) in collaboration with the Extension Department of the Municipality of Abu Dhabi retained ICBA to conduct an investigative study in these areas and propose practical solutions to restore agricultural productivity on affected farms. This study would be conducted in collaboration with SPC and an assigned project consultant, Parsons International Ltd (Parsons).

Due to the severity of the problem, it was decided to initiate the activities in the Al-Ajabn agricultural area. The Al-Ajabn agricultural area comprises 600 farms and covers more than 1,600 hectares. An initial grid consisting of 28 farms was selected in consultation with SPC and Parsons for the investigative study. Piezometers were installed in these farms to monitor ground water elevation, and water and soil samples were collected for analysis. The objective was to quantify the extent of the problem and determine patterns of ground water movement. As water is a scarce commodity throughout UAE, the identification of pollutants through chemical analyses would also help determine the best re-use alternatives.

In a separate effort, a topographical investigation was conducted throughout Al-Ajabn. A basic topographical map was prepared and used in conjunction with the analyses.

A "sink" area was identified from the synthesis of the results. This area involves six neighboring farms with a shallow water table and extreme soil salinities. A drainage system installed in this area will have a large radius of influence and excess salts can then be leached to restore agricultural productivity. A network of about 50 piezometers was installed in these farms and the neighboring area to closely monitor changes in ground water and salinity. SPC also adopted the drainage system configuration proposed by ICBA. Construction of this system started in late 2001 and is due for completion in 2002.

Once this system becomes operational, excess water will be drained over the course of six months and an affected area of over 20 hectares of agricultural land will be reclaimed. SPC is also considering another proposal by ICBA to re-use drainage water in a biosaline agriculture set-up for greening purposes.
Objectives

- Inform well-targeted audiences.
- Increase awareness of the activities of the Center.
- Establish an international network of collaborative research programs.

NEWSLETTER/POSTERS

ICBA published the third and fourth issues of the newsletter *Biosalinity News* in both English and Arabic. They were distributed to over 1200 individuals representing over 600 organizations. The publications were well received by readers.

ICBA published its first Annual Report on activities in 2000. The report was published separately in three languages - English, Arabic and French. ICBA published its Strategic Plan 2000 - 2004 in English, which has evoked positive feedback.

Twelve large 4-color posters were produced on ICBA's research objectives and activities, mentioning prominently its donors: the Islamic Development Bank, the OPEC Fund for International Development (OPEC Fund) and the Arab Fund for Economic and Social Development (AFESD). These were displayed prominently at the Consultative Group on International Agricultural Research (CGIAR) Mid Term Meeting in Durban, South Africa, in May, and at the CGIAR Annual Meeting at the World Bank Headquarters, Washington D.C., USA, held in October/November.

ICBA updated its brochure and produced two posters on ICBA's mandate and mission, and video footage for the OPEC Fund Anniversary Film.

FORGING FORMAL LINKAGES

Memoranda of Understanding (MoUs) were signed with the following organizations:

- Environmental Research and Wildlife Development Agency (ERWDA), Abu Dhabi, UAE
- International Crop Research Institute for Semi-Arid Tropics (ICRISAT), India
ICBA is now recognized as a consulting partner of the Global Water Partnership (GWP). The GWP is committed to supporting the implementation of integrated water resources management worldwide. GWP’s mission is to support countries in the sustainable management of their water resources.

ICBA’s commitment to the world body is to endeavor to efficiently maximize sustainable agriculture and horticulture by using saline and low-quality water, thus conserving global fresh water resources, especially the dwindling fresh water resources in UAE and other GCC countries, currently partially utilized in an unsustainable manner for agriculture and landscape management activities.

**PARTICIPATION IN CONFERENCES**

ICBA staff attended and participated in the following conferences:

- Environment 2001, Abu Dhabi, UAE, 4 - 8 February. Dr. M. Al-Attar chaired the session on Marine Environment and Prof. Dr. F. Taha chaired the session on Desertification.
- Fifth Annual Gulf Water Meeting, Doha, Qatar, 26 March. Dr. B. Hasbini presented a paper at the Conference.
- First International Symposium on Ornamental Horticulture in the GCC Countries, Al Ain, UAE, 5 - 7 March. Prof. Dr. F. Taha presented an invited paper in the Symposium.
- Second International Conference on Date Palms, Al Ain, UAE, 25 - 27 March. Dr. A.A. Jaradat presented a paper at the Conference.
- International Union of Soil Science, 25-27 June, Riverside, California, USA. The meeting was attended by Dr. M. Al-Attar, Prof. Dr. F. Taha and Dr. B. Hasbini.
• Planning meeting in Japan of the Third World Water Forum (WWF3), which is scheduled to take place in February 2003 as part of a joint IDB-ICBA delegation. Mr. A. Hariri attended. Consequently, ICBA and IDB were encouraged to lead a session on "Sources of alternate waters for irrigated agriculture" at WWF3 and a virtual conference session on the Internet that will precede the actual WWF3.

• Conference on Prosopis cineraria: a biometrical approach to study its genetic diversity for in situ conservation and sustainable utilization at the Faculty of Sciences, UAE University, 1 May. Dr. A.A. Jaradat attended.

• International Conference on Halophyte Utilization and Regional Sustainable Development of Agriculture held in Huanghua City, China, 15-22 September 2001. Dr. S. Ismail presented a paper at the Conference while another paper by Dr. A. Dakheel was accepted by the Conference organizers.

• International Seminar on "Genetics and Molecular Biology of Stress Tolerance in Plants", Tubitek, Turkey, 19 - 22 February. Mr. A. Hariri and Dr. S. Ismail participated.

• International Symposium and Workshop on Arid Zone Environments: Research and Management Options for Mangrove and Salt-Marsh Ecosystem, Abu Dhabi, UAE, 22 - 24 December. Dr. M. Al-Attar and the entire technical team of scientists attended.

• APAARI meeting, Thailand, 12 - 14 November. Dr. Faisal Taha participated.

• Water Week Program, Sri Lanka, 14 - 15 November. Dr. Faisal Taha participated.

**NETWORKING AND PUBLIC AWARENESS**

• ICBA initiated scientific co-operation with scientists working at the International Crop Research Institute for the Semi Arid Tropics (ICRISAT) near Hyderabad. Dr. A. Dakheel and Mr. J. Abraham visited the Central Arid Zone Research Institute (CAZRI) in Jodhpur, India. ICRISAT provided ICBA with a large amount of genetic material of pearl millet, sorghum, pigeonpea, groundnut and forage grasses, all of which had potential for salinity tolerance.

• ICBA established strong links with NyPa International, which is an R&D commercial company in the USA. Dr. M. Al-Attar and Prof. Dr. F. Taha had fruitful meetings with the company officials in June.

• ICBA prepared and produced a CD-ROM about the Center. The 20-minute program is interactive and provides details about the Center's history, mission, programs, staff and on-going activities.
• ICBA staff were interviewed by reporters of prominent dailies and magazines published in the UAE. A five-part presentation on ICBA was telecast by Dubai TV in August. An interview on ‘Environmental Protection’ involving ICBA staff was telecast on 7 July.

• ICBA participated in the following events with the display of its publications and posters:
  - Environment 2001, Abu Dhabi, UAE, 4 - 8 February.
  - Environment Day, Al Ain, UAE, 18 February.
  - ICBA Symposium on Prospects of Saline Agriculture in the GCC Countries, 18 - 20 March, Dubai, UAE.
  - Monthly meeting of Emirates Environmental Group, Dubai, UAE, 26 May.
  - An ERWDA Workshop on Environment for High School Teachers, 14 June.
  - IDB's 26th Meeting, 20 - 24 October, Algeria.
  - CGIAR Meeting, 29 October - 2 November, USA.

**ICBA LIBRARY**

By the end of the year 2001, ICBA's Library had a collection of over 1500 books and journals to benefit ICBA staff and members of its networks. A consultant reviewed the current state and needs of the ICBA library and prepared a report on the future requirements and needs of ICBA in this area. A Library Assistant was appointed for conducting the regular activities of the Library.
Training, Workshops and Extension

Objective
Promote exchange of information and experience.

TRAINING COURSES AT ICBA

Irrigation with Brackish Water, 12-16 May

Objectives
- Introduce the concept of irrigation with saline water.
- Enhance the skills of irrigation operators in management of salt-affected lands.

Participants consisted of 16 agricultural engineers from the Ministry of Agriculture and Fisheries, Dubai Municipality, Abu Dhabi Municipality, Al Ain Municipality, Environment Protection Authority of Sharjah, UAE, Ministry of Agriculture and Fisheries of Oman and ICBA.

This course provided participants with material collected from various publications on the uses of brackish and saline water in agriculture and the necessary design and management principles to ensure a sustainable production. The field demonstrations and experiments enhanced the participants' understanding of these principles. Significant feedback gleaned from the questionnaire distributed expressed the need for a special course on drainage design.

Certificates of completion were issued to those who successfully completed the course.

As a result of this training course conducted at ICBA, the Municipality of Abu Dhabi officially requested ICBA to design a drainage system for a farm severely affected by salts from a shallow brackish water table. (See Special Projects, page 27). An objective was to demonstrate the effect of drainage in an area where at least 34 similar farms are affected by the same problem.
Propagation and Management of Halophytes, 20-24 October

Objectives
- Introduce the concept of biosaline agriculture and the role of halophytic species in agricultural development systems.
- Provide hands-on training on management of halophytes including agricultural practices.
- Introduction of forage quality concepts through analytical methods.

This course provided basic information on site-specific selection of plant species and management practices that can be applied in dry and wasteland areas, using saline water resources for viable agricultural production systems.

Fourteen participants from various Ministries and municipalities attended the training course. Eight different sessions were held during the five days, including both lectures and hands on field training on field designs, planting methods, monitoring growth, assessing biomass productivity, irrigation methods, assessing soil salinity, and analytical methods for evaluating forage quality. The participants were also introduced to new equipment used in biosaline research.

Genebank Operations: Germplasm and Data Management, 22 - 26 December

Objectives
- Improve the capabilities of scientists and technicians in the national agricultural research programs to conduct regular genebank activities independently.
- Ensure that genebanks are run according to international standards.

The aim of this training course was to ensure that genebanks are run according to international standards, paving the way for conservation of viable germplasm material with high genetic diversity, and easy access to information and germplasm. Twenty participants from UAE, Oman, Kuwait and ICBA gained from attending the course. A manual for the training course was developed and distributed to participants and potential users.
ICBA held its First International Symposium "Prospects of Saline Agriculture in the Gulf Cooperation Council (GCC) Countries" in Dubai, UAE from 18 to 20 March 2001 under the patronage of His Excellency Saeed Bin Mohammad Al-Raqabani, the Minister of Agriculture and Fisheries, UAE. This Symposium was organized in collaboration with the Islamic Development Bank (IDB), the International Center for Agricultural Research in Dry Areas (ICARDA) and the UAE Ministry of Agriculture and Fisheries (MAF). His Excellency Saeed Bin Mohammad Al-Raqabani inaugurated the Conference with an opening statement followed by a speech by His Excellency Dr. Ahmad Mohamed Ali, the President of the Islamic Development Bank. Other statements were also made by the Management of ICBA and ICARDA. More than 160 delegates from 22 countries, mainly IDB member countries, attended the Symposium. The attendees endorsed specific recommendations supporting research and development work on biosaline agriculture and ICBA's efforts in this regard. ICBA received excellent feedback from VIPs and participants who commended the organization of the Symposium, the papers presented and the scientific exchange of information among attendees. ICBA was requested to convene international conferences on biosaline agriculture on a biannual basis.
International Symposium on "Research and Management Options for Mangrove and Salt Marsh Ecosystems"

ICBA co-sponsored an International Symposium on "Research and Management Options for Mangrove and Salt Marsh Ecosystems", held 22 - 24 December in Abu Dhabi, UAE. The other co-sponsors were ERWDA, United Nations Environment Programme, Regional Office for West Asia (UNEP/ROWA) and Japan Oil Development Company (JODCO).

Extension

• A four-day field visit to the Western Agricultural Area of the Emirate of Abu Dhabi was conducted in April. The results of observations and sample analyses as well as potential areas for future collaboration were compiled in a report with inputs from various ICBA scientists. This report was presented to the Extension Department of Municipality of Abu Dhabi.

• A field visit to the northern agricultural areas of the UAE was conducted on 22, 26 and 27 May. Salinity issues and productivity problems were discussed with engineers from the Ministry of Agriculture and Fisheries. Potential areas for co-operation with ICBA were identified. A substantive report was compiled and submitted to H.E. the Minister of Agriculture and Fisheries, UAE.
INFRASTRUCTURE DEVELOPMENT

Although ICBA commenced operations in September 1999, infrastructure development continues at the Center to keep pace with ICBA's growing research and development activities. Resource constraints prevented the full infrastructure development. However, during the year ICBA managed to raise some funds, at the cost of the projected technical program implementation.

New Shadehouse

The construction of the 36 m x 18 m shadehouse was completed in early October 2001. This new facility will be used for relevant greenhouse activities such as growing desert plants and hardening plant species prior to field establishment.

Irrigation System

ICBA's irrigation system was modified and expanded to accommodate new experimental requirements. Collaborative projects have specific requirements for water and salinity.

Modifications:

- Connecting the medium salinity (6 dS m⁻¹) main line to the high salinity (20 dS m⁻¹) main line thus providing high salinity water to 16.5 hectares out of 35 hectares of experimental plots initially served only by medium salinity water.
- Installation of seawater irrigation systems in two experimental plots with a total area of 2,500 m², growing various halophytes, including a number of mangrove species.
- Installation of a variable salinity system over 2000 m² for testing different forages for their salinity tolerance.

Expansion:

- Design and installation of new drip irrigation systems over an experimental area of 1.5 hectares for seed increase.
- Design and installation of bubbler irrigation systems over 1.5 hectares of experimental plots for testing the salt tolerance of 10 varieties of date palms.
- Installation of a variable salinity irrigation system for experiments conducted within the new shadehouse.

All the above activities complement on-going operations including water supply for the Center's landscape and maintenance activities.
**Windbreak Fences**

Windbreak fences extending over 800 m around the perimeter of the experimental farm were established to protect young seedlings from blowing sands. These fences, made up of 421 plants of *Azadirachta indica* (neem), *Acacia francigena*, and *Cnocadox sp.*, have proven effective in reducing wind speed and improving growing conditions for the plants.

**New Equipment**

As part of an on-going collaborative program, the International Atomic Energy Agency (IAEA) supplied a neutron probe, a set of soil augers, a soil penetrometer, a groundwater depth meter, a groundwater sampler, a Geographic Positioning System (GPS) unit and two EC meters.

**Preparation of Two Permanent Research Fields**

i. A 0.6-hectare field plot was prepared to accommodate long-term research and demonstration of two salt-tolerant grass species using a sprayer irrigation system.

ii. A 1.2-hectare research and demonstration field was prepared for long-term research and monitoring of a forage production system focusing on the use of salt-tolerant forage shrubs.

The preparation of the fields included the following steps:

- Leveling and cleaning of the site.
- Trenching and installation of irrigation lines. All main and lateral irrigation lines were installed at 70-100 cm below the surface. Individual sprayer heads can be unscrewed at 10 cm depth. This layout will facilitate mechanization of all field operations.
- The field was divided into three sections, each section for a distinct salinity level. Within each salinity level, three irrigation levels were designed (ET<sub>o</sub> 1.5 x ET<sub>o</sub> and 2 x ET<sub>o</sub>). Valves and control systems were installed to generate the required salinity and irrigation levels.
The Administration and Finance Services effectively carried out its activities and provided support to the Technical Programs Division of the Center. The major highlights follow:

**ADMINISTRATION**


**Organizational Structure.** ICBA Management approved the Organizational Structure to include three main branches, namely the Director General’s Office, the Technical Programs Division, and the Administration and Finance Division. There are four major research program areas in the Technical Programs Division. Job profiles were also approved allowing for future expansion prospects for the Center.

**The Statute.** ICBA’s statute was printed and distributed.

**Facilities.** The Center contracted the services of M/s Higgs & Hill to construct a training building. Work on the building began in late October and is scheduled for completion in March 2002. The facility will house a lecture room for 95 people and a computer room for 27 people, and will be used to provide training in the field of biosaline agriculture to scientists and technicians from the developing IDB member countries.

A new telephone system to monitor all outgoing calls of the Center was installed by M/s Scientechnic.

**STAFFING**

On completion of his secondment to ICBA in July, Mr. Hariri, ICBA’s Deputy Director General, returned to the Islamic Development Bank (IDB). He is now working in the office of the President, IDB. Mr. Hariri, a national of Saudi Arabia, was responsible for overseeing the construction of the facilities at ICBA and later for building and nurturing ICBA’s Administrative Services. He has made impressive contributions to the Center in its early years.
The following staff joined the Center:

- Dr. Abdullah Dakheel, Field and Forage Crops Scientist (January)
- Mr. Jugu Abraham, Donor Relations Specialist (March)
- Mr. Ghassan Sarris, Administration and Finance Officer (March)
- Mr. Ibrahim bin Taher Al-Mehrizi, Government Liaison Officer (September)
- Mrs. Ann Bostock, Administrative Assistant Technical Programs (January)
- Mr. Wameedh Monther Yousef, Farm Technician (March)
- Ms. Sohila Vahidipoor, Library Assistant (April)
- Mr. Sami Barakey, General Accountant (July)
- Mr. Ghazi Abu Rumman, Laboratory Technician (December)

INFORMATION TECHNOLOGY

During the period, ICBA upgraded the computer network and maintained its website. The network was expanded to handle the increased demand in terms of staff and frequency of use. Two new servers were added to handle the extra load.

EMPLOYEE CAPACITY BUILDING

To improve the employees' capabilities, effectiveness and efficiency, ICBA developed a staff development plan. Ten staff members benefited from the plan.

DONOR RELATIONS

ICBA Resource Mobilization Plan

ICBA prepared its Resource Mobilization Plan 2000 - 2009, which was presented to its major founding donor, the Islamic Development Bank.

Exemption from Water Charges from Dubai Rulers' Court

On 10 October, the Ruler's Court of Dubai decided to exempt ICBA from charges of water supplied to the Center for research purposes. This decision of in-kind support by the Rulers of Dubai is a significant contribution to ICBA, valued at US$ 0.375 million per annum. This decision emphasizes the progressive commitment of the Ruler of Dubai and of the UAE towards agricultural research and efforts to conserve natural resources in the Near East and other parts of the developing world.
OPEC Fund Grant for Training and Networking

The OPEC Fund for International Development approved ICBA’s proposal that sought support for its training programs and the web-based Global Salinity Network. However, while ICBA requested US$1.05 million over 3 years, the donor indicated its intent to provide US$ 200,000 over 2 years. This sum will only partially support ICBA’s proposed training activities and the operations of the web-based Global Salinity Network. The donor clarified that its support for training activities is restricted to the least-developed member countries of the Islamic Development Bank.

Contract Research for Petroleum Development Oman (PDO)

PDO, a private sector company, has signed a series of minor consultancy contracts and one major contract with ICBA. ICBA has already billed PDO for US$ 21,500 of which US$ 18,000 has actually been received. Other minor contracts are still in the process of implementation. A major contract for $190,000 to treat the Nimr Reed Beds and establish plots for biosaline agriculture is being developed by PDO and is likely to be approved in 2002.

Solving Waterlogging in Abu Dhabi Farms

Another project with the Emirate of Abu Dhabi to solve waterlogging and resulting salinity in important farm areas of the Emirate will provide ICBA with approximately US$ 60,000.
## APPENDIX 1 – SUMMARY OF ICBA’S GENE BANK HOLDINGS DECEMBER 2001

<table>
<thead>
<tr>
<th>SN.</th>
<th>Genus</th>
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<th>Number of accessions</th>
<th>Number of species</th>
<th>Nature of Crop</th>
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<td>60</td>
<td>Urochloa</td>
<td>Gramineae</td>
<td>1</td>
<td>1</td>
<td>Forage</td>
</tr>
<tr>
<td>61</td>
<td>Vicia</td>
<td>Fabaceae</td>
<td>11</td>
<td>1</td>
<td>Forage</td>
</tr>
<tr>
<td>62</td>
<td>Vigna</td>
<td>Fabaceae</td>
<td>408</td>
<td>1</td>
<td>Forage/pulse</td>
</tr>
<tr>
<td>63</td>
<td>Ziziphus</td>
<td>Rhamnaceae</td>
<td>2</td>
<td>1</td>
<td>Forage</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>6609</td>
<td>200</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX 2 - SUMMARY OF WEATHER INFORMATION AT ICBA STATION

Solar Radiation Data for Year 2001

Temperature Data for Year 2001

Evapotranspiration
## APPENDIX 2 (continued) – SUMMARY OF WEATHER INFORMATION AT ICBA STATION (2001)

<table>
<thead>
<tr>
<th>Month</th>
<th>Temperature (°C)</th>
<th>Relative Humidity (%)</th>
<th>Sunshine</th>
<th>Solar Radiation (W/m²)</th>
<th>Windspeed (km/hr)</th>
<th>Rainfall (mm)</th>
<th>ETo (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
<td>Min</td>
<td>Max</td>
<td>Av</td>
<td>Med</td>
<td>Min</td>
</tr>
<tr>
<td>Jan</td>
<td>3.7</td>
<td>29.5</td>
<td>16.9</td>
<td>15.6</td>
<td>23.7</td>
<td>100.0</td>
<td>75.0</td>
</tr>
<tr>
<td>Feb</td>
<td>6.0</td>
<td>33.6</td>
<td>18.9</td>
<td>17.2</td>
<td>16.3</td>
<td>100.0</td>
<td>71.5</td>
</tr>
<tr>
<td>Mar</td>
<td>10.5</td>
<td>38.8</td>
<td>26.6</td>
<td>21.9</td>
<td>13.2</td>
<td>100.0</td>
<td>62.9</td>
</tr>
<tr>
<td>Apr</td>
<td>13.5</td>
<td>42.1</td>
<td>25.2</td>
<td>24.2</td>
<td>8.2</td>
<td>100.0</td>
<td>56.2</td>
</tr>
<tr>
<td>May</td>
<td>17.4</td>
<td>48.0</td>
<td>29.9</td>
<td>31.5</td>
<td>8.32</td>
<td>100.0</td>
<td>46.7</td>
</tr>
<tr>
<td>Jun</td>
<td>21.3</td>
<td>48.3</td>
<td>32.9</td>
<td>31.8</td>
<td>9.6</td>
<td>100.0</td>
<td>56.2</td>
</tr>
<tr>
<td>Jul</td>
<td>24.0</td>
<td>49.8</td>
<td>35.9</td>
<td>36.2</td>
<td>14.3</td>
<td>98.9</td>
<td>49.1</td>
</tr>
<tr>
<td>Aug</td>
<td>22.3</td>
<td>49.9</td>
<td>34.8</td>
<td>33.7</td>
<td>11.4</td>
<td>100.0</td>
<td>49.0</td>
</tr>
<tr>
<td>Sep</td>
<td>21.4</td>
<td>48.0</td>
<td>32.4</td>
<td>32.5</td>
<td>14.4</td>
<td>100.0</td>
<td>62.8</td>
</tr>
<tr>
<td>Oct</td>
<td>15.5</td>
<td>45.3</td>
<td>28.4</td>
<td>29.9</td>
<td>13.6</td>
<td>100.0</td>
<td>67.2</td>
</tr>
<tr>
<td>Nov</td>
<td>11.8</td>
<td>39.0</td>
<td>23.7</td>
<td>23.5</td>
<td>10.6</td>
<td>103.0</td>
<td>68.5</td>
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<tr>
<td>Dec</td>
<td>12.2</td>
<td>36.3</td>
<td>22.2</td>
<td>20.4</td>
<td>21.3</td>
<td>103.0</td>
<td>77.1</td>
</tr>
<tr>
<td>Av</td>
<td>15.0</td>
<td>42.4</td>
<td>27.1</td>
<td>26.5</td>
<td>11.9</td>
<td>100.0</td>
<td>61.9</td>
</tr>
</tbody>
</table>
APPENDIX 3 – MEMORANDA OF UNDERSTANDING/AGREEMENTS AND PARTNERSHIPS

Memoranda of Understanding/Agreements

February
• Environmental Research and Wildlife Development Agency (ERWDA), UAE

March
• International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India

May
• Arab Authority for Agricultural Investment and Development (AAAID), Sudan
• King Abdulaziz City for Science and Technology (KACST), Kingdom of Saudi Arabia

October
• Arab Organization for Agricultural Development (AOAD), Sudan

December
• Ministry of Agriculture, Animal Wealth and Irrigation, State of Khartoum, Sudan
• Arabian Saline Water Technology Co. (BEHARI), Kingdom of Saudi Arabia

Partnerships
• Associate Member of the Asia-Pacific Association of Agricultural Research Institutions (APAARI)
• Global Water Partnership (GWP)
• Consultative Group on International Agricultural Research (CGIAR)
APPENDIX 4 – VISITORS TO ICBA, 2001

Ministers
- H.E. Saeed Bin Mohammad Al Raqbani, Minister of Agriculture & Fisheries, UAE
- H.E. Dr. Faisal Hassan Ibrahim, Minister of Agriculture, Animal Wealth and Irrigation, Khartoum State, Sudan
- H.E. Mr. Sleiban Omar Adan, Minister of Housing, Building, Environment & Reclamation, Djibouti

Diplomatic Missions
- H.E. Defallah H. Shumelah, Ambassador of Yemen, Abu Dhabi, UAE
- H.E. Joost Wolfswinkel, Ambassador of the Netherlands, Abu Dhabi, UAE
- H.E. Humoud Frag Bin Nader, Consul General of Saudi Arabia, Dubai, UAE
- H.E. Mr. Ahmad Mahjoob, Consul General of Sudan, Dubai, UAE
- H.E. Mr. Asoke Mukherjee, Consul General of India, Dubai, UAE
- Mr. Raid Abu Haddrah, Commercial Attaché, the Netherlands Embassy, Abu Dhabi, UAE
- Mr. Fadel Al Naqeeb, Cultural Consultant, Yemen Embassy, Abu Dhabi, UAE

International Centers/Organizations
- Dr. William D. Dar, Director General, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India
- Dr. Salem Al-Louzi, Director General, Arab Organization for Agricultural Development (AOAD), Khartoum, Sudan
- Dr. Mervat Badawi, Director of Technical Department, Arab Fund for Economic and Social Development (AFESD), Kuwait
- Mr. Abdul Hameed Al-Zarqaeli, Economic Advisor, Arab Fund for Economic and Social Development (AFESD), Kuwait
- Dr. Omar Mohammad Jouda, Regional Coordinator for Water, United Nations Economic and Social Commission for Western Asia (ESCWA), Beirut, Lebanon
- Dr. Abbas Kesseba, International Fund for Agricultural Development (IFAD), Egypt
- Mr. Adnan Shihab Eddin, Director of Technical Cooperation Programme, International Atomic Energy Agency (IAEA)
- Dr. Eddy De Pauw, Natural Resources Management Program, International Center for Agricultural Research in the Dry Areas (ICARDA), Syria
- Dr. Fawzi Karajeh, Natural Resources Management Program, International Center for Agricultural Research in the Dry Areas (ICARDA), Syria
• Dr. Miguel Clusner Godt, UNESCO-MAP, France
• Dr. Benno Boer, UNESCO, Qatar
• Dr. Andreas Kuck, Team Leader, GTZ, Amman, Jordan

**Islamic Development Bank (IDB)**
• Mr. Abdelrazie Abdelmutalib, IDB, Jeddah, Saudi Arabia
• Mr. Sulaiman Ahmed Salim, Director, Operations and Projects Department-3, IDB, Jeddah, Saudi Arabia
• Dr. Abdoul Aziz Al-Khalaf, Advisor, IDB, Jeddah, Saudi Arabia
• Mr. Jamil A. Darras, The Head, Central Accounting Section, Finance Dept., IDB, Jeddah, Saudi Arabia

**United Arab Emirates (UAE) Local Authorities**
• Eng. Rashid Mohammad Khalafan Al Shereqhi, Deputy Minister, Ministry of Agriculture and Fisheries, Dubai, UAE
• Mr. Abdul Latif Bin Hammad, Deputy Minister of Planning, UAE
• Mr. Rashid Abdul Rahman Al-Nuaimi, Manager of Planning Department, Ministry of Planning, UAE
• Eng. Mohammad Seif Al-Arrief, Deputy Director of Zayed Center, Abu Dhabi Municipality, Abu Dhabi, UAE
• Eng. Salem Al-Shekelly, Director of the Agronomy Research Laboratory, Abu Dhabi Municipality, Abu Dhabi, UAE
• Eng. Abdoul Monem Al-Marshoudi, Agriculture Extension, Abu Dhabi Municipality, Abu Dhabi, UAE
• Dr. Abdoulla Al-Najjar, Director of Research, Sharjah University, Sharjah, UAE
• Mr. Abdal Rahman Al Shamsi, Manager, Research Station, Agriculture Department, Al-Ain, UAE
• Mr. Ahmad Mohammed Abdulkarim, Director of Public Parks & Horticulture Dept, Dubai Municipality, Dubai, UAE
• Mr. Hamdan Al-Shaer, Director of the Environment Dept., Dubai Municipality, Dubai, UAE
• Mr. Ibrahim Yacoub Ali, Manager of the Office of Development and Follow-up for Environment & Public Health, Dubai Municipality, Dubai, UAE
• Mr. Mohammad Abdoul Rahman Hassan, Director of the Marine Environment Section, Dubai Municipality, Dubai, UAE
• Mr. Nabil Mahfooz Bin Haydar, Manager of the Agricultural Services Section, Dubai Municipality, Dubai, UAE
• Mr. Mohammad Ali Salem Al-Shamsi, Researcher in Applied Genetics and Plant Tissue Planting, Dubai Municipality, Dubai, UAE
• Mr. Mustapha Bin Ali Al-Shewani, Director of Planning Dept., Sharjah Government, UAE
• Dr. Ibrahim Sidawi, Executive Director, Center of Externally Funded Research Activities, UAE University, Dubai, UAE

INTERNATIONAL CENTER FOR BIOSALINE AGRICULTURE
Others

- Dr. Nicholas Yensen, Manager of NyPa International, USA
- Dr. Ragab Ragab, Principal Research Scientist, Centre for Ecology & Hydrology, Institute of Hydrology, UK
- Prof. Ali Al Jaloud, King Abdulaziz City for Science and Technology, Saudi Arabia
- Dr. Rafiq Ahmad, Biosaline Research Project, University of Karachi, Pakistan
- Dr. Yousuf Al-Ahaiji, Kuwait Institute for Scientific Research (KISR), Kuwait
- Ms. Yasmin Al-Lawati, Process, Concept Engineer, PDO LLC, Oman
- Dr. Elias Al-Tijani, Water Management & Irrigation Institute, University of Jezira, Sudan
- Prof. Dr. Adel El Prince, King Faisal University, Saudi Arabia
- Dr. Parviz Rezvan Moghaddam, Ferdowsi University, Iran
- Dr. Peter Dominy, University of Glasgow, UK
- Dr. Shafqat Farooq, Nuclear Institute for Agriculture & Biology, Pakistan
- Dr. Cherif Harrouni, Institute National de Recherche Scientifique et Tec Institut Agronomique et Veterinaire Hassan II, Morocco
- Dr. Mohammad Al Malboobi, National Research Center for Genetic Engineering & Biotechnology, Iran
- Dr. James Oster, University of California, USA
- Dr. Zahid Hussain, Pakistan Agriculture Research Council, Pakistan
- Mr. Avaz Koocheki, Ferdowsi University, Iran
- Dr. S.A.M. Cheragi, National Salinity Research Center, Iran
- Dr. Mussaddag Janat, Syrian Atomic Energy Commission, Syria
- Mr. Hussain Jawad Al Laith, Ministry of Works & Agriculture, Bahrain
- Dr. Donald S. Loch, Leader – Turf Research, Dept. of Primary Industries, Queensland Government, Australia
- Cr. Del Cole, Division 1 Councillor, Cooloola Shire Council, Queensland, Australia
- Mr. Safwan Al-Sughairi, Administration and Financial Director of the Agricultural Services Center, Khali, Palestine
- Mr. George Heading, Farm Manager - Desert Agriculture Project, GRM International Pty Ltd
- Dr. Philip Bunn, Supervisor, Engineering Programs, Al Ain Higher Colleges of Technology, UAE
- Dr. Mansour K. Mansour, Faculty Electronics Engineering Programs, Al Ain Higher Colleges of Technology, UAE
- Dr. Sabih Al Lami, Faculty Engineering Programs, Al Ain Higher Colleges of Technology, UAE
- Mr. Mohammed Al-Salhan, Director of Range and Forestry Dept. Ministry of Agriculture and Water, Saudi Arabia
- Mr. Abdulhakim Al Nass, Director of National Parks, Saudi Arabia
- Dr. Nico Marcar, Senior Research Scientist, Division of Forest and Forestry, CSIRO, Australia
- Dr. Samira Islam, King Abdul Aziz University, Saudi Arabia
- Ms. Foteh Al-Qattan, Manager, Public Relations, KISR, Kuwait
- Dr. Zahurul Karim, Secretary, Ministry of Fisheries and Livestock, Bangladesh
- Dr. Stewart Routledge, Executive Director, GRM, Queensland, Australia
- Mr. Khaled Nazal, Manager, Emirates Bio Fertilizer Factory, Al-Ain, UAE
- Dr. Tsutomu Enoki, Faculty of Agriculture, University of the Ryukyus (UR), Japan
- Mr. Yoichi Sano, Faculty of Agriculture, University of the Ryukyus (UR), Japan
- Ms. Sumie Watanabe, Faculty of Agriculture, University of the Ryukyus (UR), Japan
- Mr. Mohamad-Amin Adam, Assistant Director General, Ministry of Environment & Rural Development, Mogadishu, Somalia
- Dr. Asad Ullah Bin Ahmad Al-Ajami, Director of the Water and Soil Research Laboratories, Ministry of Agriculture and Fisheries, Oman
- Dr. Philipp Magiera, CIM-Integrated Expert, Jordan Valley Authority (JVA), Amman, Jordan
- Eng. Artur Vallentin, Agricultural Adviser, GTZ, Amman, Jordan
- Prof. Abdullah Abdelmonem, Director, Plant Pathology Research Institute, Agriculture Research Center, Egypt
- Eng. Nedal Katbeh, Senior Researcher, Ministry of Environmental Affairs, Palestinian Authority, West Bank, Palestine
APPENDIX 5 – PUBLICATIONS & PRESENTATIONS

ICBA’s Strategic Plan 2000-2004 was printed and presented to the Board of Trustees. The distribution is in progress. The 70-page, 4-color document was widely appreciated. The document outlines the new challenges in biosaline agriculture that will face the scientists at ICBA.

ICBA’s Annual Report 2000 was printed in English, Arabic and French. The staff of IDB did the French translation. This 42-page document was the first annual report of the Center.

ICBA Statute (bi-lingual – Arabic and English)


APPENDIX 6 – CORE STAFF AS ON 31 DECEMBER 2001

Office of the Director General

Dr. Mohammad Al-Attar
Mr. Ibrahim Bin Taher Al-Mehrizi
Mr. Jugu Abraham
Mrs. Hemmat Lashin

Kuwait
UAE
India
Egypt

Chairman of the Board of Directors/Director General
Government Liaison Officer
Donor Relations Specialist
Executive Secretary

Technical Programs

Prof. Dr. Faisal Taham
Dr. Abdullah Jaradat
Dr. Abdullah Dakheel
Dr. Shoaib Ismail
Dr. Bassam Hasbini
Mr. Peter Eichorn
Mrs. Mae Cutler
Mr. Mohammad Shahid
Mr. Khalil ur Rahman
Mr. Aras Assainar
Mr. Ghazi Abu Rumman
Mr. Wameedh Monther
Mrs. Ann Bostock
Mr. Ghazi Al Jabri
Miss Sohila Vahidipoor

USA
USA
Syria
Pakistan
Lebanon
Germany
Canada
Pakistan
Pakistan
India
Jordan
Iraq
UK
Syria
Iran

Director, Technical Programs
Plant Genetic Resource Scientist
Field and Forage Crops Scientist
Halophyte Agronomist
Irrigation Management Scientist
Farm Management Consultant
Library Consultant
Plant Genetics Laboratory Technician
Halophyte Laboratory Technician
Irrigation and Farm Technician
Agronomy Laboratory Technician
Farm Technician
Administrative Assistant
Administrative Assistant-Communications
Library Assistant

Administration and Finance

Mr. Ghassan Sarris
Mr. Jismal Telmasani
Mrs. Souhad El Zahed
Mr. Waseem Ali
Mr. Samir Barakey
Mrs. Shazia Khan

Canada
Saudi Arabia
Lebanon
Pakistan
Palestine
India

Administration and Finance Officer
Acting Facilities Supervisor
Office Administrator and End User Support
Administrative Assistant
General Accountant
Administration Assistant
## Statement of Activities

For the year ended 31 December 2001

(Currency: US Dollar)

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenues</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grants - unrestricted</td>
<td>2,091,461</td>
<td>2,294,854</td>
</tr>
<tr>
<td>Contribution</td>
<td>–</td>
<td>273,318</td>
</tr>
<tr>
<td>Other income</td>
<td>6,264</td>
<td>103,655</td>
</tr>
<tr>
<td><strong>Total Revenues</strong></td>
<td>2,097,725</td>
<td>2,671,837</td>
</tr>
<tr>
<td><strong>Expenses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salaries</td>
<td>698,517</td>
<td>999,662</td>
</tr>
<tr>
<td>Benefits</td>
<td>706,825</td>
<td>638,250</td>
</tr>
<tr>
<td>Suppliers</td>
<td>132,080</td>
<td>122,153</td>
</tr>
<tr>
<td>Board expenses</td>
<td>5,568</td>
<td>9,333</td>
</tr>
<tr>
<td>Contract services</td>
<td>51,884</td>
<td>87,685</td>
</tr>
<tr>
<td>Travel</td>
<td>68,995</td>
<td>112,619</td>
</tr>
<tr>
<td>Maintenance</td>
<td>66,250</td>
<td>78,219</td>
</tr>
<tr>
<td>Depreciation</td>
<td>207,534</td>
<td>282,139</td>
</tr>
<tr>
<td>Irrigation water expenses</td>
<td>85,950</td>
<td>273,318</td>
</tr>
<tr>
<td>Others</td>
<td>74,122</td>
<td>68,393</td>
</tr>
<tr>
<td><strong>Total Expenses</strong></td>
<td>2,097,725</td>
<td>2,671,837</td>
</tr>
<tr>
<td><strong>Excess of revenues over expenses</strong></td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>
Statement of Financial Position
For the year ended 31 December 2001
(Currency: US Dollar)

<table>
<thead>
<tr>
<th>Assets</th>
<th>2000</th>
<th>2001</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Assets:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash and bank</td>
<td>1,339,047</td>
<td>2,254,915</td>
</tr>
<tr>
<td>Accounts receivable</td>
<td>50,000</td>
<td>8,934</td>
</tr>
<tr>
<td>Prepayments and other assets</td>
<td>26,396</td>
<td>56,161</td>
</tr>
<tr>
<td><strong>Total Current Assets</strong></td>
<td><strong>1,415,443</strong></td>
<td><strong>2,320,010</strong></td>
</tr>
<tr>
<td>Property, plant and equipment, net</td>
<td>6,272,302</td>
<td>6,338,836</td>
</tr>
<tr>
<td><strong>Total Assets</strong></td>
<td><strong>7,687,745</strong></td>
<td><strong>8,658,846</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Liabilities and fund balances</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Liabilities:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accrued expenses and other liabilities</td>
<td>1,135,742</td>
<td>1,414,820</td>
</tr>
<tr>
<td><strong>Total Current Liabilities</strong></td>
<td><strong>1,135,742</strong></td>
<td><strong>1,414,820</strong></td>
</tr>
<tr>
<td>Provision for end-of-service benefits, net</td>
<td>11,129</td>
<td>22,286</td>
</tr>
<tr>
<td><strong>Total liabilities</strong></td>
<td><strong>1,146,871</strong></td>
<td><strong>1,437,106</strong></td>
</tr>
<tr>
<td><strong>Fund Balances</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital invested in property plant and equipment, net</td>
<td>6,272,302</td>
<td>6,338,836</td>
</tr>
<tr>
<td>Capital fund</td>
<td>268,572</td>
<td>882,904</td>
</tr>
<tr>
<td><strong>Total fund balances</strong></td>
<td><strong>6,540,874</strong></td>
<td><strong>7,221,740</strong></td>
</tr>
<tr>
<td><strong>Total liabilities and fund balances</strong></td>
<td><strong>7,687,745</strong></td>
<td><strong>8,658,846</strong></td>
</tr>
</tbody>
</table>

ICBA's external auditors, M/s Arthur Anderson & Co, have issued an unqualified audit report on the Year 2001 financial statement.
APPENDIX 8 – DONOR CONTRIBUTIONS

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
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<tbody>
<tr>
<td>IDB</td>
<td>$3,000,000</td>
<td>$3,249,375</td>
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<tr>
<td>OPEC Fund</td>
<td>$250,000</td>
<td></td>
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<tr>
<td>PDO</td>
<td></td>
<td>$18,489</td>
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<tr>
<td>BEHAR</td>
<td></td>
<td>$22,500</td>
</tr>
<tr>
<td>AFESD</td>
<td></td>
<td>$43,874</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$3,250,000</strong></td>
<td><strong>$3,334,238</strong></td>
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</tbody>
</table>
**APPENDIX 9 – LIST OF ACRONYMS**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAAID</td>
<td>Arab Authority for Agricultural Investment and Development</td>
</tr>
<tr>
<td>AFESD</td>
<td>Arab Fund for Economic and Social Development</td>
</tr>
<tr>
<td>AGAD</td>
<td>Arab Organization for Agricultural Development</td>
</tr>
<tr>
<td>APIPR</td>
<td>Arabian Peninsula Regional Program</td>
</tr>
<tr>
<td>APAARI</td>
<td>Asia Pacific Association of Agricultural Research Institutions</td>
</tr>
<tr>
<td>BCEAR</td>
<td>Arabian Saline Water Technology Company</td>
</tr>
<tr>
<td>CAZRI</td>
<td>Central Arid Zone Research Institute, India</td>
</tr>
<tr>
<td>CGIAR</td>
<td>Consultative Group on International Agricultural Research</td>
</tr>
<tr>
<td>CSIRO</td>
<td>Commonwealth Scientific and Industrial Organization</td>
</tr>
<tr>
<td>EC</td>
<td>Electrical Conductivity</td>
</tr>
<tr>
<td>ERWDA</td>
<td>Environmental Research and Wildlife Development Agency</td>
</tr>
<tr>
<td>ESCWA</td>
<td>United Nations Economic and Social Commission for Western Asia</td>
</tr>
<tr>
<td>GCC</td>
<td>Gulf Cooperation Council</td>
</tr>
<tr>
<td>GPS</td>
<td>Geographic Positioning System</td>
</tr>
<tr>
<td>GWP</td>
<td>Global Water Partnership</td>
</tr>
<tr>
<td>IAEA</td>
<td>International Atomic Energy Agency</td>
</tr>
<tr>
<td>ICARDA</td>
<td>International Center for Agricultural Research in the Dry Areas</td>
</tr>
<tr>
<td>ICBA</td>
<td>International Center for Biosaline Agriculture</td>
</tr>
<tr>
<td>ICRISAT</td>
<td>International Crops Research Institute for the Semi-Arid Tropics</td>
</tr>
<tr>
<td>IDB</td>
<td>Islamic Development Bank</td>
</tr>
<tr>
<td>IFAD</td>
<td>International Fund for Agricultural Development</td>
</tr>
<tr>
<td>JODCO</td>
<td>Japan Oil Development Company</td>
</tr>
<tr>
<td>JVA</td>
<td>Jordan Valley Authority</td>
</tr>
<tr>
<td>KACST</td>
<td>King Abdullah City for Science and Technology, Saudi Arabia</td>
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<tr>
<td>KISR</td>
<td>Kuwait Institute for Scientific Research</td>
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<tr>
<td>MAF</td>
<td>Ministry of Agriculture and Fisheries, UAE</td>
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<tr>
<td>MoU</td>
<td>Memorandum of Understanding</td>
</tr>
<tr>
<td>NARS</td>
<td>National Agricultural Research Systems</td>
</tr>
<tr>
<td>OPEC</td>
<td>Organization of Petroleum Exporting Countries</td>
</tr>
<tr>
<td>PDO</td>
<td>Petroleum Development Oman</td>
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<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
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<tr>
<td>SPC</td>
<td>Sewerage Projects Committee, Abu Dhabi</td>
</tr>
<tr>
<td>UAE</td>
<td>United Arab Emirates</td>
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<tr>
<td>UK</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>UNEP/ROWA</td>
<td>United Nations Environment Program/Region Office for West Asia</td>
</tr>
<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
</tr>
<tr>
<td>UR</td>
<td>University of the Ryukuys</td>
</tr>
<tr>
<td>USA</td>
<td>United States of America</td>
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<tr>
<td>USDA</td>
<td>United States Department of Agriculture</td>
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<tr>
<td>WUE</td>
<td>Water Use Efficiency</td>
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<td>WWF3</td>
<td>Third World Water Forum, Japan</td>
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