ICBA
Annual Report
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International
Center for
Biosaline
Agriculture

About ICBA

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.

ICBA

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.

Contents

Foreword

Over the past decade, water has risen to the top of the global development agenda. Water projects have been part of the Islamic Development Bank's programme since it was established in 1975 and, over the years, the number of water-related projects in the Bank's portfolio has risen steadily.

In arid and semi-arid regions, meeting the growing demand for freshwater is becoming increasingly challenging. As irrigated agriculture and livestock use 80-90 percent of the water in these arid and semi-arid regions, developing agricultural systems that save freshwater is critical for future economic growth and development.

The Bank took up the challenge of finite freshwater resources and salinity, which threaten the long-term viability of irrigated agriculture, and set up the International Center for Biosaline Agriculture (ICBA) to harness brackish and saline water for agriculture and develop new approaches to rising levels of soil and water salinity. The Bank, in collaboration with the United Arab Emirates Government, and with the support of the Arab Fund for Economic and Social Development, and the OPEC Fund for International Development, founded the Center in 1999.

From its initial conception, ICBA was intended to act as a focal point linking efforts in biosaline agriculture. ICBA's effectiveness will depend on the extent to which it can engage those researching and practicing biosaline agriculture and align efforts to address common problems occurring across regions and countries.

ICBA has made significant progress in its two broad areas of collaborative projects: with international programs, which primarily involve the acquisition of technology, and with countries that stand to benefit from the technology through joint projects. Such collaborative projects are a mechanism for coordinating research on biosaline agriculture among participating countries and organizations, and sharing information on the successes of biosaline agriculture among member countries.

While research and training institutes, government agencies, and non-government organisations undertake the project work required to develop biosaline agriculture, the role of member country governments is to facilitate and support new approaches to water management. Support from all these parties, partnerships and collaboration, will be needed to achieve outcomes which meet their needs and concerns.

ICBA is making substantial progress towards developing biosaline agriculture. But ICBA needs the support of national governments in member countries to commit themselves to participating in and shaping its programs.

In conclusion, I wish to acknowledge, on behalf of the ICBA Board of Trustees, the generous support of ICBA's host country, the United Arab Emirates. Likewise, the Board extends its sincere thanks to the Arab Fund for Economic and Social Development and the OPEC Fund for their committed assistance to ICBA. ICBA management and staff are to be commended on their efforts to make a success of this young institute.

Dr. Ahmad Mohamed Ali
President, Islamic Development Bank, and Chairman, ICBA Board of Trustees

Message from the Chairman, Board of Directors and Director General

ICBA is now at the half-way point in its Strategic Plan 2000-2004, and has made substantial progress against the goals it set out.

As planned, the Center is now established and fully operational, with all necessary financial, administrative, and technical facilities and mechanisms in place and functional. In 2002 the Training Center and Auditorium were completed and funds were secured from the Arab Fund to complete the irrigation in 35 hectares of experimental fields as originally intended.

A key role for ICBA is to bring to bear or adapt what is already known to solve problems in its mandate areas. The Center's success in this depends on its ability to build partnerships with national programs, including ministries of agriculture and water resources, universities and research centers in the countries where it works, as well as with regional and international research centers, development agencies and private sector companies.

In pursuit of this aim, in 2002 collaborative agreements were signed with partners in UAE, the United Arab Emirates University (UAEU), with international organizations, the Food and Agriculture Organization (FAO) and the International Atomic Energy Agency (IAEA), and with a national research institution, the Bangladesh Agricultural Research Institute (BARI). Moreover, to strengthen links with government organizations in our host country, the United Arab Emirates, ICBA opened an office in Abu Dhabi.

Important audiences for the Center's outputs are decision and policy-makers as their support is vital to the development of biosaline agriculture. The Center has made great strides in raising awareness of issues of water resources, salinity, and opportunities for biosaline agriculture with key publics. The Director General received an invitation to present a keynote address on biosaline agriculture at the World Food Prize Symposium, an annual international event. In addition, ICBA's activities in biosaline agriculture were widely covered by the national and regional media.

As planned, the Center is rapidly expanding its activities beyond Gulf Cooperation Council countries. In addition to activities in the UAE, Oman, and Bangladesh, in 2002, the Center began an assessment of saline groundwater resources in seven countries in West Asia and North Africa, funded by the International Fund for Agricultural Development (IFAD).

Water management issues in Arab countries are among the most critical of any region in the world. Over the greater part of the region, most of the precious fresh water is used in agriculture. At ICBA we are sharply focused on using brackish or salty water to replace freshwater currently used in agriculture. In this way, we believe that, in many arid and semi-arid countries as well as in Arab countries, we will make progress in our quest to meet the water challenges that face us.

In conclusion, I would like to especially thank ICBA's Chairman, Board of Trustees, Dr. Ahmad Mohamed Ali, and IDB Vice President for Operations, Mr. Amadou Cisse. With the support of IDB, and that of the Center's other donors, and the unstinting cooperation of ICBA's host country, the United Arab Emirates, the Center, through its mandate of promoting biosaline agriculture, will contribute significantly to increasing agricultural productivity, saving freshwater and improving livelihoods.

Dr. Mohammad Al-Attar
Chairman, Board of Directors, and Director General, ICBA

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* Until September 2002

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, the United Arab Emirates. 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 and Achievements

The Center's portfolio of research and technology delivery is divided into four Programs. Within each of these Programs, work is organized through projects (Table 1), each with clearly defined problems (research) or needs (information, networking and training) that are addressed. For ICBA's Technical Programs, the year 2002 witnessed substantial progress towards the goals for the first five years of operations as set out in the ICBA Strategic Plan 2000-2004.

Table 1
ICBA Projects 2002

Project Code	Funding (cash or in kind)	Collaborators	Project Title	Duration
GR01	ICBA	National and International genebanks	Acquisition, collection and conservation of plant genetic resources	2000-Continuous
GR02	ICBA		Seed increase of salt-tolerant germplasm	2000-Continuous
GR03	BEHAR	BEHAR	Development of submission of germplasm description of unique Salicornia species produced by BEHAR	2001-2003
PMS01	ICBA	ICARDA-APRP, MAF (UAE)	Evaluation of irrigation practices and fertilizer requirements for optimising productivity of two indigenous grass species	2000-2003
PMS02	ICBA	ICRISAT	Screening and evaluation of salinity tolerance, growth, yield potential and forage quality in selected cultivars/accessions of pearl millet and sorghum under field conditions	2002-2003
PMS03	ICBA	UAEU	Optimizing management practices for maximum production of two salt-tolerant grasses: Sporobolus virginicus and Distichlis spicata	2002-2006
PMS04	ICBA	UAEU	Optimizing management practices for maximum production of three Atriplex species under high salinity levels	2002-2006
PMS05	ICBA	MAF (UAE)	Application of biosaline agriculture in a demonstration farm in the Northern Emirates of the UAE	2003-2006
PMS06	ICBA	MAF (UAE)	Investigation of date palm varieties for salt-tolerance	2001-2006
PMS07	PDO	PDO	Demonstration of biosaline agriculture at Nimr, Sultanate of Oman	2001-2004
PMS08	SPC, Abu Dhabi	SPC, Abu Dhabi	Managing salinity and waterlogging in coastal agricultural areas in Abu Dhabi	2002-2003
PMS09	ICBA, BARI	BARI	Demonstration of biosaline agriculture in salt-affected areas in Bangladesh	2003-2004
PMS10	IFAD		Assessment of saline water resources in the WANA region	2002-2003
PMS11	ICBA		Mass screening of halophytes	2002-Continuous
PMS12	ICBA		Water use and salt balance of halophytic species	2000-Continuous
PMS13	ICBA, IAEA MAF (UAE)	IAEA, MAF (UAE)	Sustainable utilization of saline ground water and wastelands for plant production	2000-2005
PMS14	ICBA, ERWDA	ERWDA	Increasing biodiversity of mangrove species in the UAE: Introduction and adaptation of new species	2002-2003

Acquisition, collection and conservation of plant genetic resources

Little has been done to collect and characterize salt-tolerant plants found in arid areas. Action is needed to collect these salt-tolerant genetic resources as a foundation for the development of agricultural systems based on saline irrigation. ICBA has a specialized and unique role in evaluating salt-tolerant plant resources. A major goal of ICBA in its first four years is to acquire, catalogue and characterize accessions of salt-tolerant plant genetic resources.

Thus the ICBA genebank has been established to conserve maximum genetic diversity for seed increase and dissemination to partners in the Gulf Cooperation Council countries and the Islamic world as well as to provide reliable information to partners on available germplasm. The aim is to increase the germplasm base of major crops (forages and halophytes in particular) to increase the chances of developing sustainable crop/plant production under saline conditions.

In its first three years, ICBA acquired over 6,700 accessions and, in 2002, the backlog of germplasm introduced but not grown out was tackled. ICBA is continuing to acquire salt-tolerant species as a basis for applied plant science research. In 2002, 143 accessions and nine new species were acquired for ICBA's genebank, making a total of 6,752 accessions of 209 species.

Salt tolerant forage crops

Over half the irrigated area in the Gulf Cooperation Council (GCC) countries is planted to forage crops. It is well known that forage crops differ widely in their tolerance to salinity. Many forages have been collected from different parts of the Middle East, but few have been evaluated for salt-tolerance. Hence, screening and characterizing the forage germplasm is essential for it to be used productively. ICBA first

Technical Programs

screens germplasm of forage crops for their tolerance to salinity, then evaluates promising species for their nutritional value as animal feed and to assess their productivity.

Screening showed that the potential forage crops, Omani landrace barley, safflower, buffelgrass and alfalfa, were potentially salt-tolerant and 10% were selected for further investigation. Pearl millet in particular has great potential as a forage crop at high salinity.

Results of evaluation for productivity show that the salt-tolerant grasses *Sporobolus* and *Distichlis* produce comparable biomass to common forages in the region. Investigations of four species of *Atriplex*, a salt-tolerant shrub widely used as a forage crop, showed that at 25 dS/m, *Atriplex nummularia* produced more biomass (grazeable leaves and stems) than *A. canescens*, *A. undulata* and *A. lentiformis* and is thus the most promising as a forage shrub.

The forage grass *Chloris gayana* (Rhodes grass) produced more biomass at low, medium and high salinity than *Cenchrus ciliaris* and *Coelachryum pierci* but biomass production was reduced by 41% at high salinity.

Results of investigations of the effect of saline irrigation on the soil showed that irrigation of *Atriplex* with saline water was found to have no negative effect on the soil, and soil salinity was reasonably controlled after one-and-a-half years.

Screening and evaluating halophytes

Many plants are salt-tolerant but few are used in agriculture or greening programs although animals have grazed halophytes in arid and semi-arid areas for millennia. ICBA's role is to identify halophytes that could be used in productive agriculture or greening programs and to make them available to farmers and landscapers.

Six accessions of potential forage halophytes *Lathyrus sativus* (a field pea) and six of *Lotus corniculatus* (a trefoil) were screened and showed high salt tolerance. Investigations of the tree species *Acacia ampliceps* (salt wattle) showed that it is potentially useful for forage production under saline irrigation as minimum salt accumulation occurs in its rhizosphere.

As well as investigating potential forage halophytes, ICBA develops and enhances halophytes for other uses, especially as landscaping plants and ornamentals. Three mangrove species from Japan and Pakistan were acquired and are being evaluated for use in coastal greening programs.

Documentation of salt-tolerant species as a consistent set of data is essential. In 2002 a start was made on collecting this data and documentation was compiled for 89 salt-tolerant trees, plants and groundcover.

Improving management of soil salinity and fertility

Controlling salinity is a complex issue that requires special agronomic and ecologic practices. Careful soil and water management is essential to avoid harm to the soil when irrigating with saline water. To improve soil and water management ICBA is developing soil-specific procedures to maintain root-zone salinity at an acceptable level for crops irrigated with varying levels of saline water.

Investigations showed that *Salvadora persica* produced higher stem and leaf biomass at high volumes of irrigation compared to low volumes. However, the soil salinity was twice as high at high volumes compared to low volumes. *S. persica* is a large shrub which bears edible berries and tolerates salinity up to seawater.

Evaluating and documenting date palm genetic resources for salinity tolerance

Farmers cultivate a large number of date palm varieties in the Middle East. These differ tremendously in quality as well as in their tolerance to salinity. Given the importance of the date palm both in the economy and to the society in the Middle East, ICBA established a long-term experiment to evaluate the best ten date palm cultivars from the United Arab Emirates for salt tolerance. In 2002, eight varieties from Saudi Arabia were added.

Outreach

The end-users of the technical products of ICBA's programs are farmers. ICBA has made excellent progress in developing technology packages to address priority salinity problems regionally and globally. In 2002, technologies developed at ICBA were being applied in three countries. Firstly, in the Northern Emirates of the UAE, an integrated farm management demonstration began on a salt-affected farm in Northern Emirates. In Abu Dhabi Emirate, a pilot drainage system decreased waterlogging and salinity on 21 farms over 58 hectares. Secondly, in Oman, a three-hectare demonstration of biosaline agriculture using saline treated oil production wastewater was set up at Nimr for Petroleum Development Oman. The demonstration is an outcome of a very successful project in which ICBA investigated operations and recommended modifications that led to significant improvements in treating process water existing reed beds. Lastly, in Bangladesh, fields were prepared for a demonstration of agricultural practices to mitigate effects of salinity in rice paddies.

Networking and managing information

ICBA is developing networks among those involved in research on biosaline agriculture to focus and streamline efforts to address common problems across countries and regions. The Center aims to establish formal (Memorandum of Understanding or similar agreement) or informal (project based or individual contacts) collaborations for accessing technology.

In 2002, ICBA signed Memoranda of Understanding with The Food and Agriculture Organization (FAO), the International Atomic Energy Agency (IAEA), the Bangladesh Agricultural Research Institute (BARI), and the United Arab Emirates University (UAEU). Joint programs for the delivery of biosalinity technology have been developed and are underway with IAEA, BARI and UAEU.

The year 2002 was the third year of publication of the Biosalinity Newsletter, which contains news and articles on biosalinity and ICBA's second annual report, ICBA Annual Report 2001, was published. In a further contribution to providing access to information on biosaline agriculture, the managed e-network, the Global Biosaline Network (GBN) on ICBA's website provided on-line access to comprehensive bibliographic databases to members.

A further step in networking in biosaline networking was taken during the COMSTECH meeting in Islamabad in February 2002, when the establishment of the Inter-Islamic Network on Biosaline Agriculture (INBA) was approved and ICBA was designated to host the network.

Developing human resources and transferring technology

ICBA needs well-trained partners if it is to establish effective collaborative research and development projects. Training in technical aspects of saline irrigated agriculture is thus a key role for ICBA. In 2002, ICBA conducted three training courses on irrigation management techniques, sustainable production systems for biosaline agriculture, and agro-ecological surveys and germplasm collection. Two workshops on marginal water were also held as part of international conferences in Dubai. In all, over 100 trainees from 25 IDB-member countries attended.

The first MSc student to be provided facilities and supervision for thesis research successfully completed his studies in 2002.

About the Program

The Plant Genetic Resources Program introduces new germplasm of potential new species for cultivation under saline conditions. It evaluates new germplasm for adaptation and multiplies seed for evaluation of salinity tolerance, storage and distribution to collaborators.

Objective

The overall objective of the Program is to promote agricultural production and environmental greening under saline conditions. Its immediate objectives are to identify and acquire germplasm of new species, and to generate sufficient plant material for screening for salinity tolerance. It stores germplasm with a view to providing interested scientists with germplasm of salt-tolerant crops and halophytes.

Background

Salinity-tolerant forage and browse species are considered to have the greatest potential for integration into farming systems that use saline irrigation water. The Program has therefore concentrated on identification and acquisition of potential forage and browse species of crops and halophytes. For crops, large numbers of accessions of few species have been introduced, to look for within-species variation for salinity tolerance. For halophytes, few accessions of many species have been introduced to concentrate on between-species variation in salinity tolerance. Many of the introduced species also have potential use as greening and ornamental plants. Most of the germplasm has been acquired from existing genebanks with free exchange policies.

ICBA will continue to introduce salinity-tolerant forage and browse species of crops and halophytes. Gradually, the range of species acquired and conserved will be broadened to include those with adaptation to other regions and to include vegetables and fruits. ICBA will continue to acquire germplasm predominantly from existing collections but will also assist national programs collect and evaluate the salinity tolerance of native species.

Plant Genetic Resources Program

Project GR01 Plant genetic resources: acquisition, collection and conservation

Duration: On-going
Collaborators: National and International genebanks.
Funding: Core

Background

This core project is on-going and has two basic objectives. The first is to identify and acquire genetic materials with potential for use in saline irrigated agriculture for testing in ICBA's programs and those of our collaborators. The second objective is to create a germplasm collection from which other scientists can access, from a single source, salinity-tolerant species and accessions together with information about their salinity tolerance and other characteristics. By the end of 2001, 6,609 germplasm accessions belonging to 200 species had been acquired.

Progress 2002

In 2002 ICBA continued to acquire new species and accessions of salt-tolerant and potentially salt-tolerant germplasm but at a very much-reduced rate. The slow down in the pace of acquisition was attributable to two causes. Firstly, there was staff movement that left the position of Plant Genetic Resources Scientist unoccupied for the first half of the year. Secondly, time was needed to reduce the

backlog of germplasm that had been acquired but not yet grown out. As a result, only a few new accessions were added to the collection during the year. As of 31 December 2002, the holdings of the genebank stood at 6,752 accessions of 209 species. The full details of the holdings by genus are shown in Appendix 1.

Plans 2003

Acquisition and introduction of new accessions and new species will be continued in 2003. A target of approximately 2,000 new accessions will be set as this is likely to be the limit that can be effectively handled for initial characterization, seed increase and subsequent evaluation for salt tolerance in any one year. For 2003, attention will be focused on obtaining further germplasm of the cereals that have already shown promise (barley, pearl millet and sorghum), with a view to increasing the diversity of genetic material under test. ICBA will also continue to obtain new forage species, including browse trees and shrubs. As in the past, the aim will be to acquire most of the new germplasm from existing genebanks.

Project GR02 Seed increase of salt-tolerant germplasm

Duration: On-going
Collaborators: N/a
Funding: Core

Background

Initial characterization and seed increase of introduced germplasm was started in previous seasons. Several sets of materials planted in 2001 remained in the field for evaluation during 2002 and several new sets were grown. These included annual species for which evaluation was completed during the year, and perennials for which evaluation will continue over several seasons. Since the main objective of this exercise was to multiply seed for further testing, the germplasm was grown under irrigation with fresh water.

Progress 2002

Material from 2001

Barley *(Hordeum vulgare)*: A set of 2,084 barley lines was sown in November 2001 and harvested in the spring of 2002. The lines were derived from a single landrace from Oman, from which single-head selections were made in the 2000-2001 winter season. Days to 50% heading and grain yield were recorded for each line. Visual estimates of biomass accumulation, plant type (grain, forage or dual purpose types), and lodging were also made.

The growth of the crop was excellent with good vegetative growth and grain yields. Days to 50% heading showed a wide range (Figure 1). The earliest lines headed in less than 65 days while the latest took over 135 days to reach heading. As shown in Figure 1, the distribution of days to 50% heading showed clear modes at 80-85 and 105-110 days, with indications of a further mode at 130-135 days after sowing.

Omani landrace barley

Based on days to 50% heading, visual estimates of biomass accumulation, grain yield and plant type, a stratified sample of the material was selected for field evaluation of salinity tolerance in the 2002-2003 winter season. The selected lines, together with a number of ICARDA lines as standards of comparison, were sown for further seed increase in November 2002.

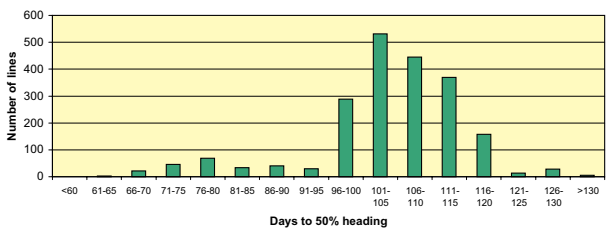


Figure 1 Frequency distribution of days to 50% heading in 2,084 barley lines. Al Ruwayyah, 2001-2002.

Triticale (X Triticosecale): Over 900 accessions of triticale were obtained earlier. Initial grow outs were also attempted in previous seasons but failed for a variety of reasons. In order to obtain a better evaluation of the potential for cultivation of triticale, a subset of the original accessions were grown.

The subset comprised 360 accessions and was sown in November 2001. Germination and growth were adequate but far from impressive. As in previous seasons, the crop proved to have problems, notably bird damage during the seed setting and ripening stages. As a result, seed was only harvested from 254 of the accessions grown. Triticale was assessed to have much less promise than barley as a forage cereal for the UAE and similar environments and will not be investigated further at this time.

Buffelgrass *(Cenchrus ciliaris)*: A collection of buffelgrass accessions, mainly received from USDA, were sown in November 2001. The early establishment and vegetative growth of this perennial forage grass were slow during the cool winter months but picked up with increasing temperatures. Of the 858 accessions grown, 508 flowered in early 2002. However, few heads were borne and seed set was poor. Of the 508 accessions that flowered, no seed at all was recovered from 185. The percentages of seed set obtained from the remaining 323 lines which produced seed are shown in Table 2, which confirms the poor seed quality. The amounts of seed obtained were small in all cases.

Table 2 Number of accessions and percentage seed set for buffelgrass *(Cenchrus ciliaris)* harvested in May/June and October/November, Al Ruwayyah, 2002

Percentage Seed Set	Number of Accessions	
	May-June Harvest	Oct - Nov Harvest
1-10	268	2
11-20	30	6
21-30	12	18
31-40	5	36
41-50	4	23
51-60	2	25
61-70	0	18
71-80	1	10
81-90	1	5
91-100	0	7

In September, the buffelgrass plants were cut back to a height of approximately 10 cm. Regrowth after cutting was rapid and luxuriant. A further flush of flowering occurred on 150 of the accessions. Seed was harvested in October and November. Both the quantity and quality of seed obtained in October/November was higher than in May/June. Table 2 shows the numbers of accessions with different percentages of seed-bearing florets.

New materials sown in 2002

Several sets of potential forage legumes were sown in February 2002 for evaluation of their adaptation and for seed increase. These included 250 accessions of alfalfa (*Medicago sativa*), 254 accessions of 3 species of vetches (*Lathyrus* spp.), 408 accessions of mung bean (*Vigna radiata*), and 44 accessions of lablab (*Lablab purpureus*). In addition, 640 accessions of the oilseed safflower (*Carthamus tinctorius*) were evaluated. The experiences with each are described briefly below.

Alfalfa *(Medicago sativa)*: The accessions established well and generally grew well throughout the year. Some unidentified disease problems were encountered during the cool months when dew formation appears to have created conducive conditions for disease development and spread. A small number of accessions died due to disease. The plants were cut back twice during the year to evaluate regeneration and persistence at different times of the year. In general the performance of alfalfa was extremely promising.

No seed was harvested during the year although flowering and seed set were observed. This was because alfalfa is a cross-pollinating species and an effective mechanism to control insect access and prevent pollination between accessions was not yet in place. However, this is planned for the cool months at the beginning of 2003.

Plant Genetic Resources Program

Vetches (*Lathyrus* species): The vetches germinated and grew well in the cool spring months. However, as temperatures rose, they began to suffer and eventually all the accessions died out. They appear poorly suited to spring sowings. There are no immediate plans to pursue further testing but they may be tested again at a later date in an autumn sowing.

Mung bean (*Vigna radiata*): The mung bean proved slightly better adapted than the vetches. Many accessions grew well in the cooler months, but as temperature rose, some began to die out. Of the 408 accessions planted, only 187 produced seed. In all cases the quantity of seed was very small. As with the vetches, the mung bean does not appear promising for spring sowings, but may be tested again later in autumn sowing.

Lablab (*Lablab purpureus*): Lablab showed excellent vegetative growth throughout the year, including the hot summer months. Some accessions flowered more or less continuously but failed to set seed in the hot months. Towards the end of the year, however, as temperatures declined, excellent seed set was obtained from more than half the accessions (24 out of 44 planted). The accessions continued to grow and flower until the end of the year and it is anticipated that seed will be harvested from several more in the early months of 2003. In view of its excellent vegetative vigor and ability to grow throughout the hottest months, lablab is believed to have excellent promise as a potential forage crop.

Safflower (*Carthamus tinctorius*): Most of the safflower accessions proved well adapted to United Arab Emirates conditions. The plants grew well and 595 out of the 640 planted produced good seed. Safflower appears to offer high promise as a potential oil crop and will be screened for salinity tolerance in 2003.

Out of 640 safflower accessions, 595 produced good seed

In addition, several sets of genetic material were planted in November 2002 for evaluation. These include grasses (149 accessions of 9 *Echinochloa* species, 116 accessions of *Chloris gayana*, and 76 accessions belonging to 16 *Sporobolus* species), forage legumes (240 accessions of *Melilotus officinalis*, 241 of *Melilotus albus*, and 16 accessions of 5 *Hedysarum* species) and other potential forage species (50 accessions of *Beta vulgaris*). As these remain at the establishment stage, they are not discussed further at this time but will be reported on in future.

Evaluation of seed: The quality of seed harvested at different times from the crops that had multiple flushes of flowering is being evaluated to determine the optimum harvest time. Harvesting and quality evaluation of the perennial species *Cenchrus ciliaris*, *Medicago sativa* and *Lablab purpureus* are ongoing.

Selections for further investigation: Based on agronomic characteristics, including days to 50% flowering, assessment of biomass productivity, and seed yields, approximately 10% of the Omani landrace barley, safflower, buffelgrass

and alfalfa were selected for further investigation of their salinity tolerance.

Plans 2003

The harsh climatic conditions in the United Arab Emirates during summer - with extremely high temperatures, desiccating winds and blowing sands - present major challenges to crop selection and management. Many of the species with reputations of resistance to salinity, which are of interest to ICBA, are adapted to more moderate climates. Many are completely unable to survive in the UAE. Others are unable to reproduce or do so only with difficulty. For most there is no recorded information on sowing dates and crop management in UAE conditions and ICBA will continue to experiment on a best-guess basis, and by trial and error, on how best to obtain good plant stands and high quality seed.

Screening new species for adaptation and to increase seed will continue. The species and accession sown in November 2002, mentioned above, will form a large part of the program for 2003. In addition, new materials will be identified for spring sowings. At the same time, experiments on sowing and harvesting dates to optimize quantity and quality of seed production for different species will continue.

Of the materials that have already under undergone initial evaluation, future work will concentrate on the barley (*Hordeum vulgare*), buffelgrass (*Cenchrus ciliaris*), lablab (*Lablab purpureus*) and safflower (*Carthamus tinctorius*) for which adequate quantities of seed have been produced for evaluation of salinity tolerance. In addition, increasing seed of accessions of sorghum and pearl millet that are at more advanced stages of screening and evaluation of productivity will continue.

Project GR03 Development and submission of germplasm description of unique *Salicornia* species produced by BEHAR

Duration: Extended to 2003
Collaborators: Arabian Saline Water Technology Company (BEHAR).
Funding: BEHAR

Background

For approximately two decades, a number of organizations and national agricultural research organizations have been investigating the potential of *Salicornia* species, irrigated with pure seawater, for agricultural production. BEHAR, a private company based in Saudi Arabia, has been at the forefront of this research in the Arabian Peninsula. BEHAR approached ICBA for assistance in identifying homogeneous lines of *Salicornia* and in preparing a description of the material suitable for crop or germplasm registration.

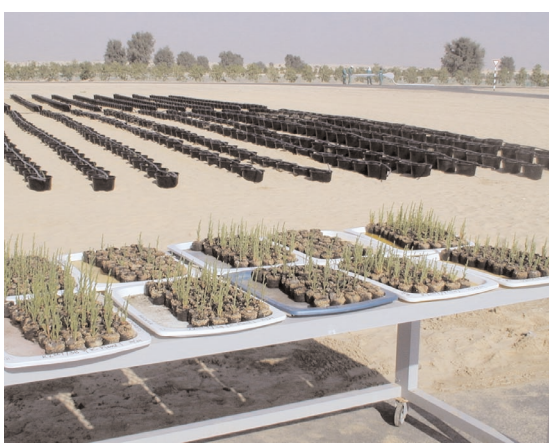
Progress 2002

BEHAR provided seed of 24 lines of *Salicornia bigelovii* for investigation. Seeds were sown at the end of October 2001 in jiffy pots in a greenhouse at 28°C and irrigated with fresh water. After three weeks, seedlings were moved out of the greenhouse into full sunlight. At two months of age the seedlings were transplanted into buckets at the rate of two plants per bucket and gradually, over a period of three weeks, exposed to irrigation

with seawater. From the end of the third week after transplanting until maturity, the plants were irrigated with 100% seawater.

From the beginning of June 2002, data on a number of morphological and growth characteristics were recorded on ten *Salicornia* plants for each of the study lines. Visual impressions of the growing plants and the recorded data indicated that most of the lines were heterogeneous for obvious color and morphological traits. A certain amount of variation is to be expected within lines of *Salicornia bigelovii* because it is a cross-pollinating species. However, the distinct differences that were found within the majority of the lines were felt to be inimical to establishing their uniqueness and distinctness from other *Salicornia* lines. Five of the study lines were relatively more uniform, however, and were selected for further study.

DNA was extracted from the five lines identified as relatively homogeneous and subjected to AFLP (amplified fragment length polymorphism) analyses. Two restriction enzymes and four primer sets were found to reveal differences between and within lines. The AFLP technique appears effective for possible fingerprinting of *Salicornia* lines.



Two-month old *Salicornia* ready for transplanting into buckets and irrigation with sea water

Plans 2003

Due to a number of technical difficulties in 2002, the trial was established in pots rather than the field and the number of plants studied for each of the *Salicornia* lines was restricted. This made it impossible to reliably describe the within and between line variation for registration purposes. It was therefore decided to extend the project into 2003, when a larger number of plants (c. 100 per line) grown in the field will be studied.

Production and Management Systems Program

About the Program

The Production and Management Systems Program develops sustainable irrigation and land management systems that use saline water for crop production, and evaluates field, forage, horticultural and halophytic crops production under irrigation with water ranging from moderately to highly saline.

Objective

The objective of the Program is to evaluate and select new and improved varieties of field and forage crops and to investigate sustainable and improved management techniques for their ability to sustain economic production under irrigation with moderately to highly saline water.

Background

Over half the irrigated area in the Gulf Cooperation Council countries is planted to forages. Thus, ICBA believes that the greatest opportunity for use of saline irrigation water lies in developing forage production systems based on salt-tolerant conventional and non-conventional forage plants. The strategic focus of the Production and Management Systems Program is therefore on forage crops that can grow in marginal areas under irrigation with saline water, for example in coastal areas and where freshwater resources are not available or are in short supply.

Conventional crops known to be salt-tolerant to some degree, pearl millet and sorghum, are being screened and evaluated to establish the most salt-tolerant varieties for development. In parallel, management practices for non-conventional salt-tolerant grasses and shrubs are being developed. Appropriate fertilizer application, irrigation and crop harvesting practices are being developed and tested under production conditions using varying salinity levels of irrigation water.

The performance of irrigation systems and the influence of local conditions are critical to the success of biosaline agriculture. Technologies are being tested for demonstration to end users to help them operate sustainable, productive saline irrigation systems.

Project PMS01 Evaluation of irrigation practices and fertilizer requirements for optimizing productivity of two indigenous grass species

Duration: 2000-2003
Collaborators: International Center for Agricultural Research in the Dry Areas - Arabian Peninsula Research Program (ICARDA-APRP), Ministry of Agriculture and Fisheries (MAF), UAE
Funding: ICBA

Background

Within the Arabian peninsula there is a range of salt-tolerant indigenous grass species that can be developed as forage. This includes *Coelachyrum piercei, Cenchrus ciliaris* and *Lasiurus scindicus*. However, much less is known about the agronomic practices (establishment, fertilizer regimes, crop management and harvesting) needed for sustainable production. This project aims to develop and disseminate optimal management practices for these grasses under saline irrigation.

Progress 2002

Growth and biomass productivity of two indigenous grass species (*Coelachyrum piercei, Cenchrus ciliaris*) and *Chloris gayana* (an introduced species widely grown and thus an appropriate standard of comparison) were studied at a range of irrigation water salinity, irrigation volume and nitrogen fertilizer treatment. Growth and biomass productivity were measured for the different treatments. Soil salinity was monitored both by extracting soil solutions from core samples and by direct measurements using an EM-38 soil electrical conductivity meter.

The three grass species (*Coelachyrum piercei, Cenchrus ciliaris* and *Chloris gayana*) grown at 3,500-10,500 ppm (5-15 $dS.m^{-1}$) were harvested at different times of the year (Figure 2) and growth and biomass production were measured.

The trial site before and after harvest

Results

Biomass production varied with salinity. *C. gayana* exhibited higher shoot biomass (fresh, dry and ash-free dry weight) as compared to other species at different salinity treatments. However, it showed a 41% reduction at high salinity (10,500 ppm) as compared to low salinity (3,500 ppm). *C. ciliaris* exhibited a reduction of only 21% at 10,500 ppm compared to low salinity. All three grasses showed highest ash-free dry weight (AFDW) at a nitrogen application rate of 40 kg/ha and irrigation level of 100% ET_0 (ET_0 x 1.0) followed by water application at 50% ET0 in a split dose. The average AFDW (for a single cutting) at high salinity varied from 4.12-5.78 t/ha for *C. piercei*, 4.85-5.94 for *C. ciliaris* and 4.88-6.09 for *C. gayana*.

Soil salinity measured by an EM-38 soil electrical conductivity meter for the 0-150 cm depth interval exhibited relatively higher salinity at 100% ET_0 for all the species at low and medium salinity levels (Figure 2). However, at high salinity (10,500 ppm), 50% ET_0 (applied as a single dose) showed more soil salinity. However as an EM-38 soil electrical conductivity meter prediction is based on the 0-150 cm soil profile, soil sampling at 0-75 and 75-150 cm showed soil salinity to be relatively higher in the upper 0-75 cm at 100% ET_0 and lower at 50% ET_0 (both for single and split doses of water application).

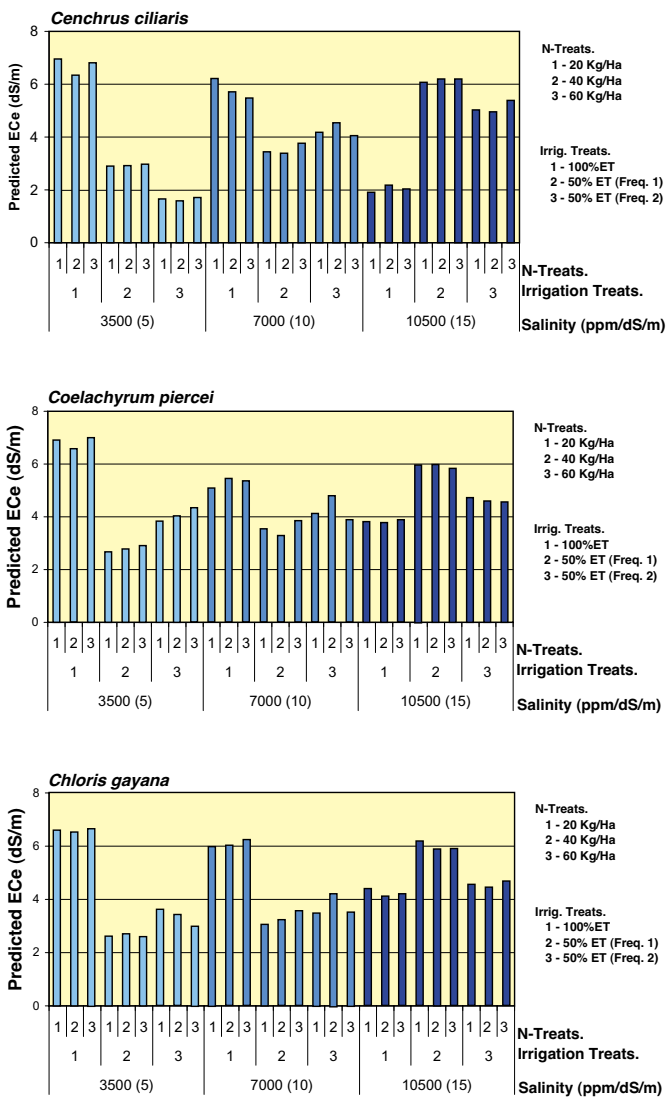


Figure 2 Soil salinity measured by an EM-38 soil electrical conductivity meter for 0-150 cm depth interval at low, medium and high salinity, 20, 40 and 60 kg N-treatment and 100%, 50% (single) and 50% (split) irrigation

Plans 2003

The trial will be continued to determine the long-term effects of different treatments and their effects on seed production and viability. Currently seeds are being collected for the different treatments applied. Germination work will continue in 2003.

Project PMS02 Screening and evaluation of salinity tolerance, growth, yield potential and forage quality of pearl millet and sorghum under field conditions

Duration: 2002-2003
Collaborators: International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
Funding: Core

Background

Cereals are among the top targeted crops by ICBA for the development of salt-tolerant genotypes. In addition to being highly important for food and feed, many of the important cereal crops also show large genetic variations for many traits, including salinity tolerance. As the Center is not involved in breeding programs to generate salt-tolerant plants, it collaborates with other international research organizations to evaluate salinity tolerance of material they have already developed. ICBA is collaborating with the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) to evaluate salinity tolerance in pearl millet, which is considered to be one of the most important feed and food crops and which has great potential for expansion into many parts of the world including the West Asia and North Africa region.

Progress in 2002

Evaluation of salinity tolerance, growth, yield potential, and forage quality of 42 varieties of pearl millet under field conditions

Based on promising results of evaluation of several pearl millet genotypes in 2000 and 2001, 42 elite varieties were acquired from ICRISAT. In 2002 these 42 elite varieties were evaluated for salinity tolerance and general adaptation to the regional environmental conditions. The ultimate objective is to select salt-tolerant genotypes that are suitable both for biomass (forage) and seed production.

Preliminary results during 2002 showed that there are many varieties of pearl millet that have a good potential for biomass production, or for both seed and biomass production, under high salinity levels up to 15 dS/m. Varieties that are salt-tolerant and suitable for mild winter and/or summer growth were also identified. At the same time sufficient seeds of each variety were produced to maintain research and demonstration activities.

Spring planting

The maximum total above-ground biomass production from varieties planted in spring was

Spring planting of 42 pearl millet varieties at three salinity levels

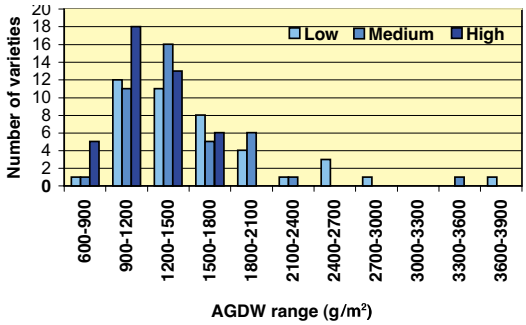


Figure 3 Above-ground dry weight (AGDW) in 42 pearl millet varieties at low (5 dS/m), medium (10 dS/m) and high (15 dS/m) salinity (spring planting)

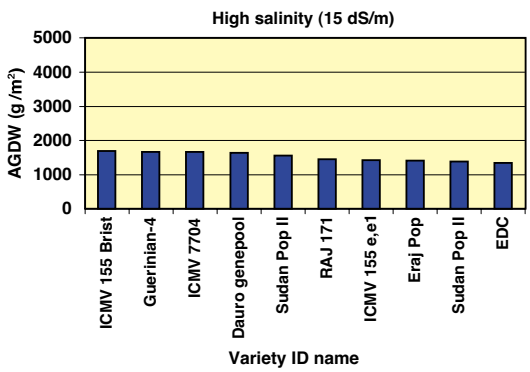


Figure 4 Above-ground dry weight (AGDW) in 10 top-yielding pearl millet varieties at high salinity (15 dS/m)

3900 g/m² at low salinity. At high salinity, maximum yields were in the 1500-1800 g/m² range (Figure 3).

Top yielding varieties at high salinity are shown in Figure 4. Some varieties showed consistent yield in the range of salinity evaluated. Seed yield was not affected to the same degree as biomass at the high salinity level.

Fall planting

Average yields from varieties planted in the fall were significantly lower than yields from the spring planting (Figure 5).

Maximum production was around 500 g/m², far less than the spring planting. At high salinity the maximum biomass ranged from 200-300 g/m² (Figure 6). Seed yield was less affected. Early heading contributed to the lower yield observed from the fall planting.

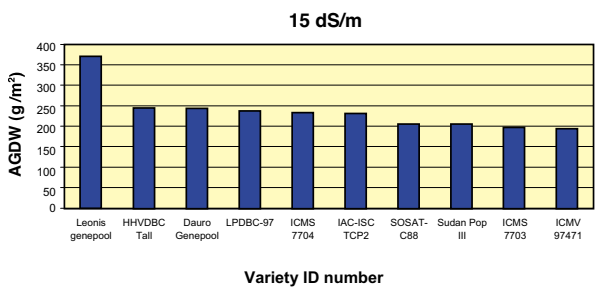


Figure 6 Above-ground dry weight (AGDW) in top 10 pearl millet varieties at high salinity (15 dS/m)

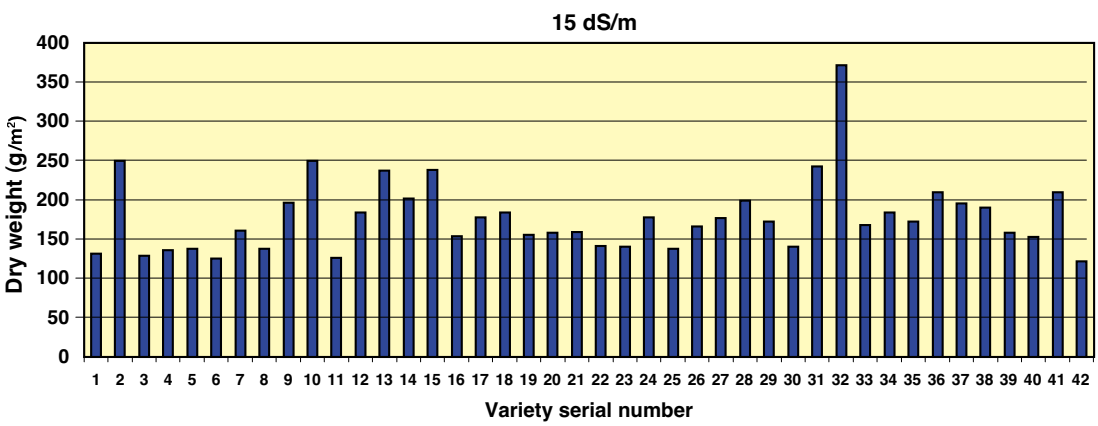


Figure 5 Above-ground dry weight (AGDW) in 42 pearl millet varieties at high salinity (15 dS/m)

Production and Management Systems Program

Plans 2003

Planting dates will be adjusted to minimize the effects of short day length on early flowering.

Screening for salinity tolerance among 49 selected pearl millet accessions

In addition to the 42 elite varieties of pearl millet described above, 49 pearl millet accessions, representing a wide range of genetic diversity with high potential for biomass production, were also acquired by ICBA from ICRISAT's core collection. During 2002 these accessions were evaluated for salinity tolerance, biomass and seed production under field conditions.

Initial observations show that there is a wide range of biomass and seed production among the 49 accessions and that there is great potential for selecting accessions that are productive at high salinity levels.

Biomass production was significantly higher in the 49 pearl millet accessions than in the 42 pearl millet varieties that were selected at ICRISAT for high seed yield. At low salinity, biomass production ranged from a few hundred to more than 15,000 g/m^2 (Figure 7).

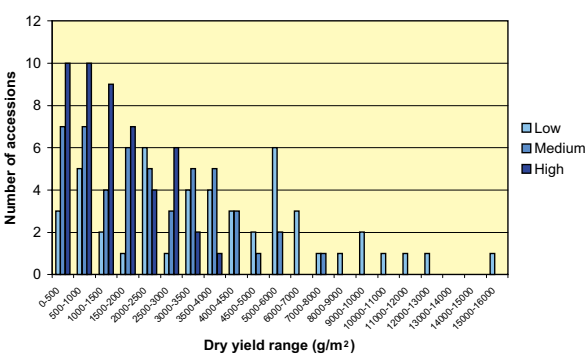


Figure 7 Above-ground dry weight in spring planting of 49 pearl millet accessions at low, medium and high salinity (5, 10, 15 dS/m)

Wide variations in biomass production among 49 pearl millet accessions at low salinity (5 dS/m)

At higher salinities the range of biomass production narrowed, but high yielding varieties performed very well even at 15 dS/m (Figure 8). High-yielding varieties will form the basis for subsequent selection and improvement of pearl millet for salt-affected environments.

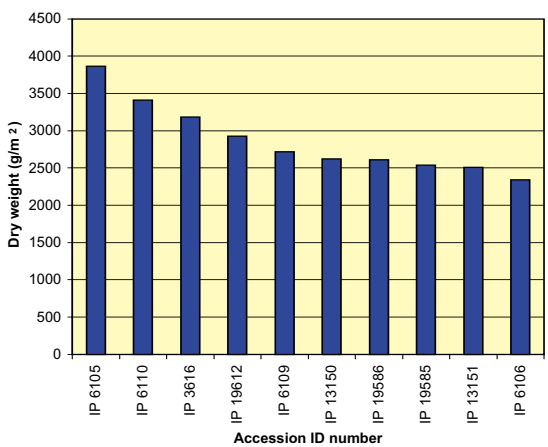


Figure 8 Above-ground dry weight in spring planting of 10 top yielding pearl millet accessions at high salinity (15 dS/m)

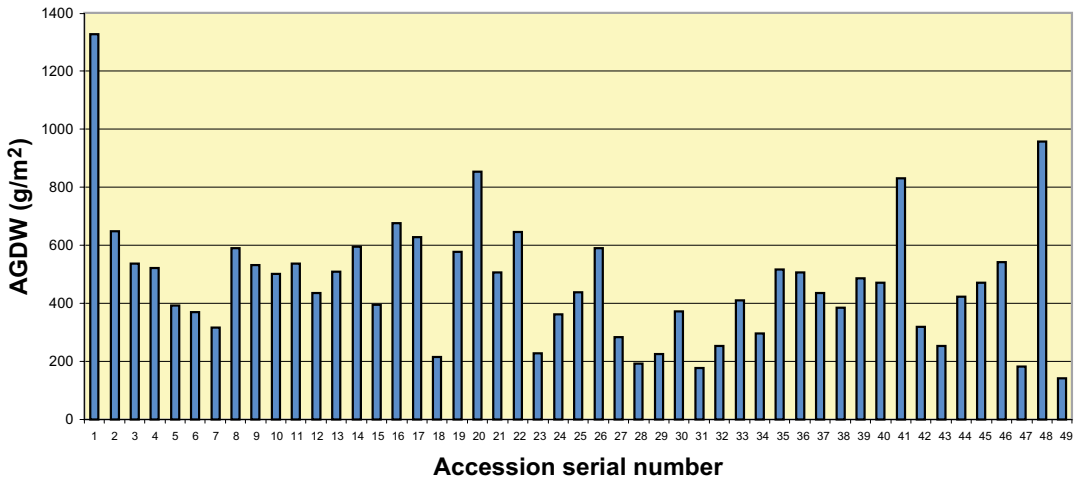


Figure 9 Above-ground dry weight (AGDW) in fall planting of 49 pearl millet accession at medium salinity (10 dS/m)

Fall planting

Fall planting of the 49 pearl millet accessions showed similar trends to fall plantings of the 42 varieties. Biomass production was substantially lower than spring planting. Yet biomass production was significantly higher compared with biomass production of the 42 varieties (Figure 9).

At medium salinity, biomass production in the 49 accessions was more than double the biomass production in the 42 varieties.

Plans 2003

The same 49 pearl millet accessions and 42 pearl millet elite varieties will be evaluated at three salinity levels. Planting dates will be adjusted to achieve maximum growth under the prevailing environmental conditions. By the end of 2003, a set of salt-tolerant genotypes from both accessions and varieties will be identified. This set of salt-tolerant genotypes will be available for use by collaborating national programs in the region, and also for further evaluation of productivity under a wide range of salinities and management practices.

Screening for salinity tolerance among 87 sorghum accessions and 54 sorghum varieties

Like pearl millet, sorghum is also an important feed crop in tropical and sub-tropical environments. ICBA, in collaboration with ICRISAT, is evaluating 87 sorghum accessions and 54 elite varieties for salinity tolerance at 5, 10 and 15 dS/m.

Accessions and varieties examined showed a wide range of production and growth traits. They were evaluated for their growth potential and salinity tolerance in fall 2001 and spring 2002 plantings.

Fall planting

Preliminary observations show that few of the sorghum accessions and varieties evaluated grow well or tolerate salinity at the relatively low temperatures experienced during the mild winters of the United Arab Emirates.

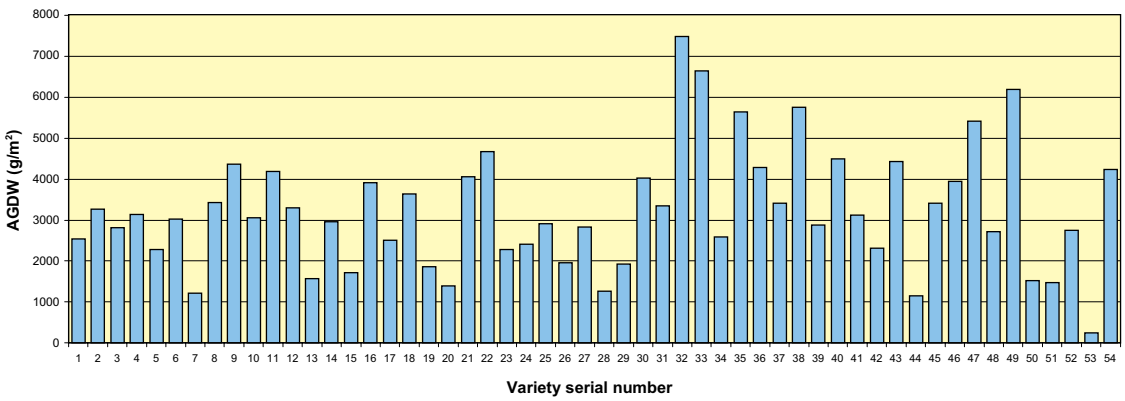


Figure 10 Above ground dry weight (AGDW) in spring planting of 54 sorghum varieties at low salinity (5 dS/m)

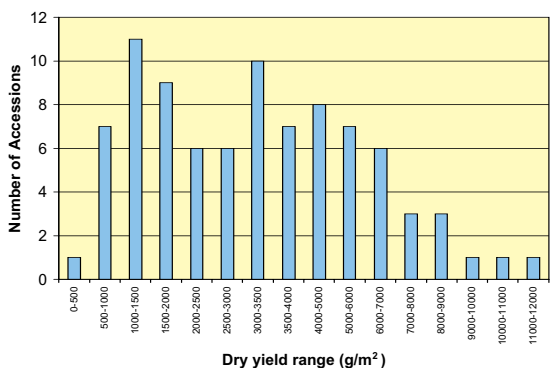


Figure 11 Above ground dry weight (AGDW) in spring planting of 87 sorghum accessions at low salinity (5 dS/m)

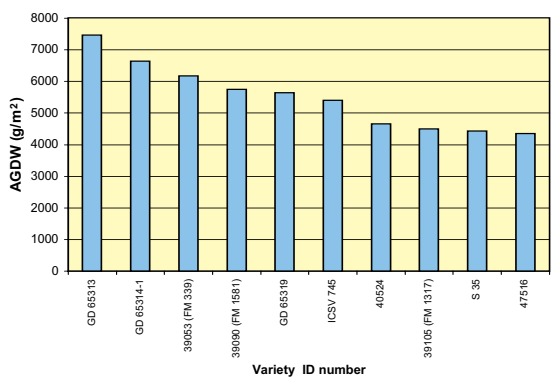


Figure 12 Above ground dry weight (AGDW) in spring planting of 10 top-yielding sorghum varieties at low salinity (5 dS/m)

Spring planting

Most of the accessions and varieties planted in spring 2002 performed well at low salinity with dry biomass production up to 12,000 g/m^2. However, at high salinity levels, few accessions and varieties grew well or produced seed. Detailed results are presented for low salinity (Figures 10, 11, 12).

Plans 2003

Planting dates will be adjusted to minimize effects of lower temperatures and day length on potential growth of sorghum varieties and accessions. More emphasis will be given to spring/summer planting.

Project PMS03 Optimizing management practices for maximum production of two salt-tolerant grasses: *Sporobolus virginicus* and *Distichlis spicata*

Duration: 2002-2006
Collaborators: United Arab Emirates University (UAEU), Al-Ain.
Funding: Core, UAEU

Background

Long-term field studies on the economic feasibility and sustainability of forage production systems that are based on the use of non-conventional salt-tolerant grasses and highly saline waters are very limited internationally, and not available for the region. In order to assess such forage production systems, two highly salt-tolerant grasses, *Sporobolus virginicus* and *Distichlis spicata*, were selected to establish a large field for research and demonstration at ICBA's headquarters. The grasses were selected on the basis of previous evaluation of their salinity tolerance, nutritional value, suitability for mechanical harvesting and handling for economic large-scale production.

The objectives of this project are to determine:

- Yield potential of the two grasses when grown under high salinity levels, and the level at which productivity remains economical.
- Optimum irrigation level for maximum production of the two grasses, and the level that minimizes salt accumulation in the soil.
- Appropriate fertilizer regime for maximum production.
- Nutritional value of the two species in response to the different salinity, irrigation and fertilizer levels.

In 2001, more than 70,000 seedlings of each of the two grass species were produced by vegetative propagation producing enough plants to establish two factorial field experiments in October-December 2001, on about 5,500 m^2. These experiments evaluated the effects of management inputs on the productivity of the two salt-tolerant grasses. Productivity was assessed at three salinity levels (10, 20 and 30 dS/m), three irrigation levels (ET_0, 1.5 x ET_0 and 2 x ET_0) and four fertilizer treatments (NPK 0, 50, 100 and 150 kg/ha).

Progress 2002

The experimental field was fully established by the summer of 2002. An initial cutting was made to bring the field to an even level. The three salinity levels and four fertility treatments were applied thereafter. After less than three months of growth the first cut was taken from both species.




Established fields of *Distichlis spicata* and *Sporobolus virginicus*. Mechanical harvesting and baling

Production and Management Systems Program

Initial results show that biomass production in both species was comparable with some common forages in the region. Fresh weight of *Sporobolus* and *Distichlis* exceeded 1,500 g/m^2 and 2,000 g/m^2 respectively (Figure 13). Large-scale field yields ranged from 5-8.5 tons per hectare (Figure 14). When comparing dry weights, the sampling and large-scale field yields are very comparable. Generally yields of both species were higher at the medium and high salinity levels than at the low level. *Distichlis* had a significantly higher yield at the high salinity level.

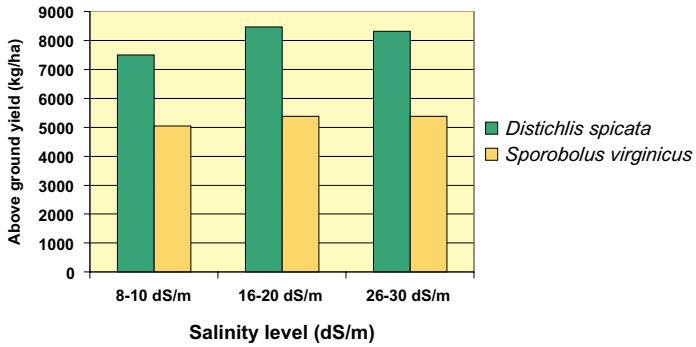
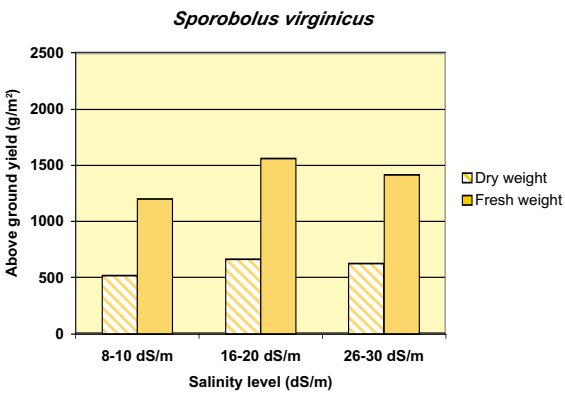
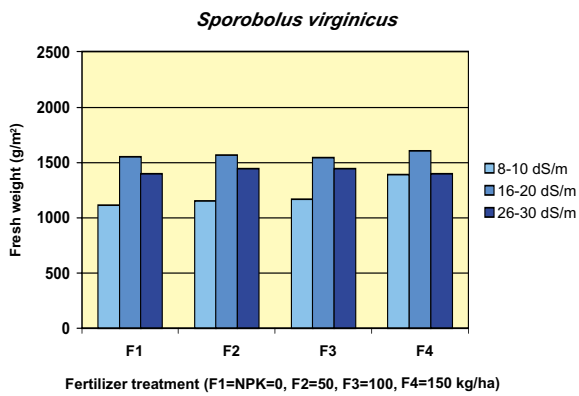
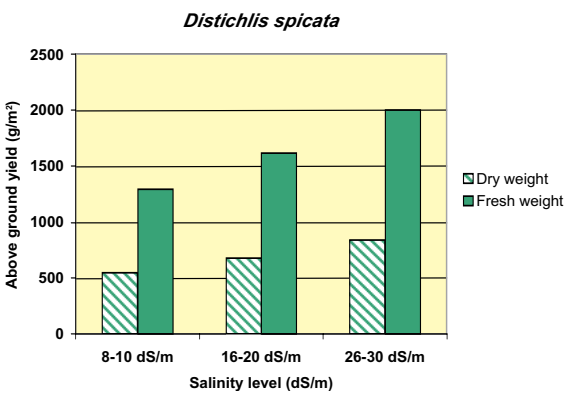


Figure 14 Large scale field dry weight production in *Distichlis spicata* and *Sporobolus virginicus* under three salinity levels (first cut from 5,500 m^2, means over all fertilizer applications)







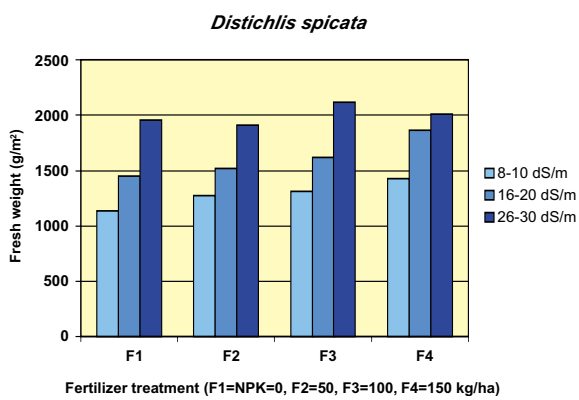


Figure 13 Mean dry and fresh matter production in *Sporobolus virginicus* and *Distichlis spicata* at first cut grown at three salinity levels (means over all fertility levels)

Figure 15 Above ground fresh matter in *Sporobolus virginicus* and *Distichlis spicata* at different combinations of salinity and fertilizer application (first cut)

With the progress of time and repeated applications of the different salinity and fertility treatments, it is expected that the cumulative effects will be reflected in biomass production and will confirm the pattern observed in the first cut.

Interactions between the different fertilizer treatments and salinity levels show that higher applications of fertilizer positively influence yield at low salinity (10 dS/m) in both species (Figure 15), while at medium and high salinity levels only the yield of *Distichlis* was improved by high applications of fertilizer.

Project PMS04 Optimizing management practices for maximum production of three *Atriplex* species *(Atriplex halimus, A. nummularia, A. lentiformis)* under high salinity levels

Duration: 2002-2006
Collaborators: United Arab Emirates University (UAEU), Al-Ain
Funding: Core, UAEU

Background

Atriplex is well known for its salt tolerance and its value as a high-protein feed for animals. However, animals do not thrive if they are fed solely on a diet of *Atriplex* because it contains a high concentration of mineral salts. However, a mix of salt-tolerant grass and shrubs can provide a balanced diet.

This project, like the grass project (PMS03), assesses the potential production, feasibility and long-term sustainability of forage production systems based on salt-tolerant forage shrubs, and has the same objectives.

Nearly 5,000 cuttings from the three *Atriplex* species were produced in 2001 and used to establish three factorial experiments, one for each species, on a 1.5-hectare field. The plants were assessed at three salinity levels (10, 20 and 30 dS/m), three irrigation levels (ET_0, 1.5 x ET_0 and 2 x ET_0), three plant densities (2 x 2 m, 2 x 1.5 m and 2 x 1 m) and six fertilizer treatments.

Progress 2002

The three species were well established by summer 2002. Three salinity levels and six fertility treatments (NPK, 0, 16, 32 and 48 g/plant, and two levels of N alone at a rate of 0, 10.5 and 21 g/plant)

Atriplex field showing the height of cut (above); recovery after cutting showing different planting densities (below)

Production and Management Systems Program

were applied in two doses one month apart. The first cut was in July 2002. Plants were cut back to 30 cm, removing nearly two thirds of above ground biomass.

Initial results show that fresh and dry biomass production was highest at the medium salinity level in *A. halimus* and *A. nummularia*, while biomass in *A. lentiformis* was higher at the high salinity level. The latter species had a significantly higher total yield at all salinity levels than the other two (Figure 16). Yield increased with increase in density level at all salinity levels (Figure 17). At low density, the highest average yield for all species was at medium salinity. The degree of leafiness is an important trait in forages, *A. halimus* had a higher leaf area and weight at the high salinity level, although total yield was higher in *A. lentiformis* (Figure 18). At the large-scale field level (1.5 ha), total biomass at first cut followed a similar pattern to the results from samples. *A. nummularia* and *A. halimus* showed higher yields at medium salinity, while *A. lentiformis* biomass increased with the increase in salinity level (Figure 19).

As stated earlier, this long-term research and demonstration field aims at to evaluate the productivity and sustainability of a salt-tolerant shrub production system. The evaluation is in the early stages and it is expected that long-term patterns will emerge over the next few years.

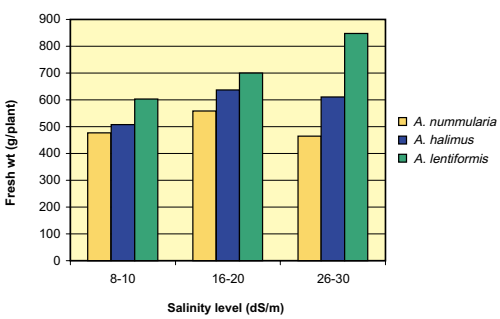


Figure 16 Total fresh above ground biomass production at first cut in three *Atriplex* species grown at three salinity levels

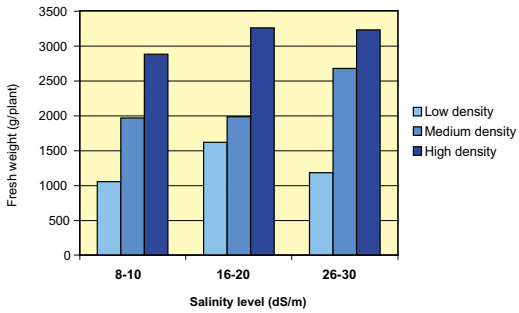


Figure 17 Mean biomass production at first cut of three *Atriplex* species grown at three density and salinity levels

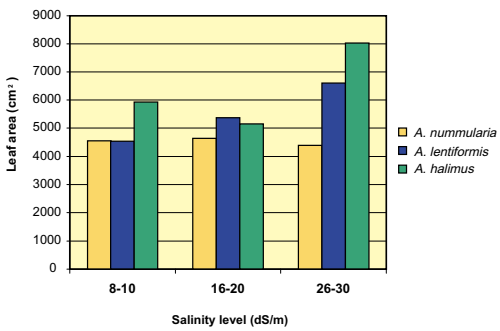


Figure 18 Total leaf area at first cut in three *Atriplex* species grown at three salinity levels

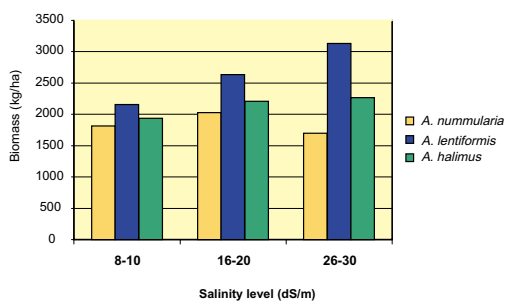


Figure 19 Total field biomass production at first cut in three *Atriplex* species at three salinity levels

Plans 2003

In 2003 the three different irrigation levels will be applied. Harvest will be done periodically at 4-month intervals and chemical analysis of the three species at all combinations of the different treatments applied will be performed. By the end of 2003 feeding trials in sheep and goats will start.

Project PMS05 Application of biosaline agriculture in a demonstration farm (Ras al Khaimah) in the Northern Emirates of the UAE

Duration: 2003-2006
Collaborators: Ministry of Agriculture and Fisheries (MAF), UAE
Funding: Core, MAF

Background

Irrigated agriculture in the United Arab Emirates has increased dramatically over the last 30 years. Yet few farmers have the special skills and techniques required. This project will demonstrate biosaline agriculture techniques to farmers and show how sustainable and profitable plant production is possible on farms affected by moderate to high levels of salinity. The demonstration farm will be a model for reclamation of salt-affected farms in the region.

Specific objectives are to:

- Apply integrated farm management methods suitable for salt-affected farms in the Northern Emirates.
- Demonstrate the principles of biosaline agriculture for producing conventional and non-conventional forage crops.
- Study and monitor the physical, chemical and productive aspects, of the demonstration farm, including soil, water and forage production, over a three-year period.
- Involve local farmers and technicians in the evaluation of the project and organize field days.

Progress 2002

ICBA and MAF developed a plan for demonstrating biosaline agriculture on 0.425 ha in Ras Al-Khaimah (UAE), including appropriate irrigation and drainage methods, and cropping systems. Crops will include shrubs, conventional and non-conventional salt-tolerant annual and perennial forages.

Scientists from ICBA and MAF taking soil samples from the salt-affected farm selected for demonstration of biosaline agriculture

Plans 2003

Appropriate irrigation and drainage systems will be installed on the selected farm in collaboration with the MAF technical team. Biosaline agriculture plant production systems and plant species will be introduced on the farm as the project progresses. Farmers, MAF, and ICBA technicians will be involved in the process.

Project PMS06 Investigation of date palm varieties for salt-tolerance

Duration: 2001-2006
Collaborators: Ministry of Agriculture and Fisheries (MAF), United Arab Emirates
Funding: Core, MAF

Background

Few studies have examined the long-term effects of salinity on date palm growth and productivity from establishment to maturity. This long-term experiment, planned to run for five to six years, will provide valuable information on the salinity tolerance of ten elite UAE date palm varieties. In collaboration with the UAE MAF, ten of the most preferred date palm varieties – Khalas, Faradh, Barhi, Lulu, Djibri, Naghal, Khasab, Khanizi, Shahle and Abu Maan – were selected for investigation. The ten varieties were planted in 2001 in a replicated field experiment at three salinity levels, with five replications of each variety, totaling 150 trees.

Progress 2002

In March 2002, 27 trees that failed to establish were replaced with saplings of the same age. At the end of September 2002, trials at three salinity levels (5, 10 and 15 dS/m) began. Height, trunk diameter, number of leaves and phenology are being recorded for each plant. As the ten varieties have dissimilar characteristics, the relative growth will be used to compare development of the different varieties at the three salinity levels.

In November 2002, eight varieties from Saudi Arabia were planted in the same field under the same salinity treatments, along with four varieties of olive. The group of 18 elite varieties will provide data for the evaluation of the impact of salinity on date palm production in the region.

Date palm field 18 months after transplanting (above); addition of eight Saudi date palm and four olive varieties (below)

Plans 2003

Growth and development, soil salinity and other traits will be monitored. Relative growth of each variety under the various salinity levels will be assessed at the end of the year.

Project PMS07 Demonstration of biosaline agriculture at Nimr, Sultanate of Oman

Duration: 2001-2004
Collaborators: Petroleum Development Oman (PDO)
Funding: Petroleum Development Oman

Background

Petroleum Development Oman (PDO) produces 550,000 m^3/day of saline process water along with its oil production of 135,000 m^3/day. This process water is not readily usable as it contains oil and heavy metal contaminants. At present, approximately 330,000 m^3/day is disposed of by injection into shallow and deep aquifers. The injection process is costly and the environmental effects are unknown. For these reasons, PDO is investigating the use of inexpensive biological treatment systems as an environment-friendly solution to water disposal.

Biological treatment systems have been successfully used for wastewater treatment in many parts of the world. In such systems, aquatic plants grown in treatment ponds and irrigated with partially treated effluent water remove pollutants by a variety of physical and microbiological mechanisms.

PDO constructed a pilot project for the biological treatment of process water in the Nimr area in Southern Oman in early 2000. The project has an area of 5 hectares and consists of reed treatment beds and water evaporation facilities. The site was designed to treat 2,000 m^3/day.

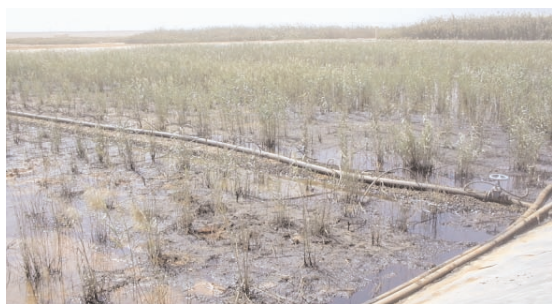
A rigorous monitoring program was established to monitor the operation and performance of the treatment beds. For a variety of reasons, the treatment process was found to be inadequate and the level of pollutants beyond set limits.

In 2001 ICBA was invited to investigate the causes of the malfunction of the treatment process. Following a series of investigations and analyses, the treatment bed operations were modified and improved significantly.

Encouraged by these results PDO adopted a treatment process design prepared by ICBA and transformed an existing empty plantation bed into a reed bed treating process water. It was further decided to establish a biosaline agriculture demonstration project, which would be irrigated using treated process water.

Progress 2002

Construction of bed A1 started in December 2001 and was completed in April 2002. Analyses



Treatment of oil process water and biosaline agriculture pilot project at Nimr, Oman. Reed bed irrigated with oil process water (above). Treated effluent from the reed bed (below)

Oil degradation at the roots of reeds (above). Biosaline agriculture demonstration pilot project (below)

suggest that the newly established reed bed is treating process water to unsurpassed levels.

The area of the biosaline agriculture demonstration project is 3 hectares and the design includes earthworks, the layout of the irrigation and drainage system, and the planting scheme. Trees, shrubs, and grasses will be utilized in this demonstration site.

A full evaluation of the reed bed system was performed, including a comprehensive analysis of operational and monitoring data. Also included in the evaluation was an economic analysis of various alternatives for using the effluent and guidelines for designing reed beds.

Plans for 2003

The biosaline agriculture demonstration project was commissioned in December 2002. The pilot scale trial includes forage, forestry, agro-forestry production systems, and re-use of drainage water. Salt-tolerant crops, grasses, shrubs and trees will be planted in early 2003. Plants will be monitored closely and evaluated with reference to the quality of water applied and productivity.

Project PMS08 Managing salinity and waterlogging in coastal agricultural areas in Abu Dhabi

Duration: 2002-2003
Collaborators: Sewerage Projects Committee (SPC), Abu Dhabi Municipality
Funding: Sewerage Projects Committee, Abu Dhabi Municipality

Background

A shallow brackish water table underlies the coastal agricultural areas of Al-Ajban, Al Smeeh and Al Rahbah, north of Abu Dhabi. Over the years, irrigation water collected in natural depressions. As a result, many agricultural areas were flooded and the depth-to-water was less than 50 cm.

The capillary rise of irrigation water and native brackish water caused deposition of salts (mostly sodium chloride) on the soil surface, thus reducing soil permeability and weakening plant growth. The increase in soil salinity has had a net negative effect on agricultural production. In addition, the waterlogged soils deprived roots of essential oxygen, causing suffocation and rotting. The productivity of many new farms, particularly those located in depressions, declined over just two years of farming.

The Sewerage Projects Committee (SPC) of the Municipality of Abu Dhabi approached ICBA for help in addressing these problems and tackling the increased salinity. Due to the magnitude of the problem, a pilot area of Al-Ajban was selected and a drainage system installed. Groundwater and soil salinity are being monitored to provide information on the performance of the drainage system and this information will be used to refine the design for drainage systems in other areas of Al-Ajban as well as in other agricultural areas.

Data was collected on the elevation of the water table, salinity, the chemical composition of water, agricultural activities and productivity from a rectangular grid of 28 farms covering all of Al-Ajban area. Piezometers were installed on these farms for sampling water and monitoring the water table. In addition, a basic topography survey was conducted to delineate depressions and identify problem areas.

Progress 2002

The results, combined with information from farmers, confirmed that the rising water table resulted from accumulated irrigation water rather than rising native groundwater. A pilot area was selected and a drainage system was designed and installed. To monitor the performance of the drainage system in relation to waterlogging and to determine the radius of influence of the drainage system, 44 additional piezometers were installed.

Salts deposited on the soil surface

Dewatering for installation of drainage system

Piezometer in a farm

Drainage outflow in the collection sump

Restored production in a previously affected farm.

Groundwater and irrigation water samples were collected and water level and salinity measurements were taken at all piezometers.

Irrigation and groundwater samples were analyzed for major and trace chemical elements to determine the suitability of groundwater for re-use. Results indicated that the levels of most ions are within safe limits for re-use, although the overall total dissolved solids content is high. The pilot drainage system decreased waterlogging and salinity on 21 farms covering 58 hectares around the pilot project farms. Another 19.5 hectares benefited from the pilot project although waterlogging was non-existent on these farms in 2002. The daily outflow from the pilot drainage network varied from 700 m^3 in summer to 1,500 m^3 in winter.

A final report on the performance of the pilot drainage system was submitted in December 2002.

Plans for 2003

Based on the performance of the pilot drainage system, SPC decided to design a drainage system for the entire Al-Ajban area, covering 1,800 hectares of agricultural land. These activities are planned for 2003.

Project PMS09 Demonstration of biosaline agriculture in salt-affected areas in Bangladesh

Duration: 2002-2004
Collaborators: Bangladesh Agriculture Research Institute (BARI)
Funding: ICBA, BARI

Background

Following a visit to Bangladesh by ICBA management and technical staff, Bangladesh Agriculture Research Institute (BARI) prepared and submitted a proposal for bilateral cooperation. ICBA provides funds and technical expertise whilst facilities and manpower are provided by the Bangladesh Agriculture Research Institute (BARI).

Rice paddy in Bangladesh affected by salinity.

Salt-affected soil in a rice paddy.

The project aims to develop agricultural practices to mitigate the effects of salinity in rice paddies during the dry months of the year. Seawater intrusion into the low-lying rice paddies causes the fields become saline. If successful soil and water management practices (including modern irrigation systems) can be developed, crops such as tomato, mustard, barley and chili will be grown. These crops have a higher cash value than rice and will help improve the livelihood of poor farmers in two districts: Feni and Satkhira.

Progress in 2002

ICBA and BARI signed the contract in October 2002 and field preparation began although seasonal rains in December 2002 caused some delays.

Plans for 2003

Field preparation will be completed in February 2003 and trials will begin.

Project PMS10 Assessment of saline water resources in the West Asia and North Africa (WANA) region

Duration: 2002-2003
Collaborators: N/a
Funding: International Fund for Agricultural Development (IFAD)

Background

The assessment of saline water resources in the West Asia and North Africa (WANA) region was undertaken by ICBA on behalf of the International Fund for Agricultural Development (IFAD).

Progress 2002

The objective was to assess the quantities of available saline water suitable for irrigated biosaline agriculture (Total Dissolved Solids 6,000-15,000 ppm) in selected countries in the West Asia and North Africa (WANA) region. Assessments involved seven countries: Syria, Oman, Yemen, and Jordan in West Asia; and Algeria, Tunisia, and Libya in North Africa.

The terms of reference for the study were to:

- Review the available hydrogeological studies and validate their results through selected field visits.
- Assess the underground and surface saline waters that could be economically mobilised for irrigation using the available technology for biosaline agriculture being generated by ICBA.
- Quantify the water resources at three salinity levels: moderate (less than 3,000 ppm), brackish (3,000-6,000 ppm), and high salinity (6,000-15,000 ppm).
- Assess the quality of soil and land available for saline irrigation and located within a reasonable distance from water sources on the basis of cost-effective water transfer.

The assessment began in November 2002 and will be completed by February 2003.

Plans for 2003

The report will be submitted in February 2003.

Project PMS11 Mass screening of halophytes and salt-tolerant plants

Duration: On going
Collaborators: N/a
Funding: ICBA

Background

Halophytes are an untapped genetic resource that could be used to develop crops that can be grown in saline environments. These and other wild plants, if domesticated, can be grown using saline water and saline soils for agricultural production. However, a number of species and accessions show differential responses in terms of germination, and seedling and vegetative growth. It is therefore necessary to determine background information about the salt-tolerance levels before the germplasm can be introduced for a field trial. The screening is

carried out in a set-up fabricated at the center using an automatic gravel hydroponic system.

Progress in 2002

Selected germplasm received from different sources was evaluated using the rapid screening systems (Table 3).

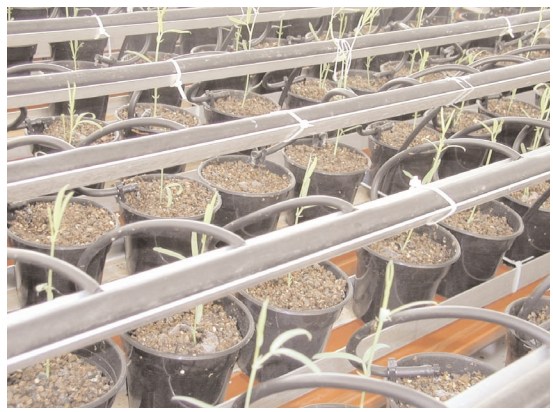
Table 3 Species and accessions tested in 2001-2002

Species and accessions tested		Salinity Range
Plant Species	Accessions Tested	(dS/m)
Melilotus officinalis	36	10-40
Cenchrus ciliaris	18	10-40
Lotus corniculatus	42	10-40
Lathyrus sativus	84	3-15
Triticosecale	48	3-15
Sporobolus spp.	12	3-15
Total	240	

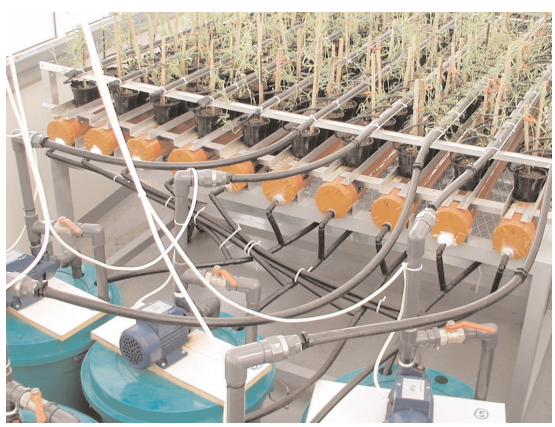
Results

In 2002, 150 accessions were evaluated including *Lotus corniculatus, Lathyrus sativus* and *Triticosecale*. Among the three species, *L. sativus* exhibited high salt tolerance and among the 84 different accessions screened, 40 accessions showed threshold salinity values between 9-12 dS/m, and 6 accessions exhibited 100% survival and growth at 15 dS/m. Twenty-four accessions, however, failed to germinate and establish even at 9 dS/m, whereas the rest showed moderate response to salinity levels. Six accessions of *L. corniculatus* exhibited high salt tolerance with threshold values ranging from 11-17 dS/m, whereas the rest of the accessions failed to establish beyond 14 dS/m.

Plants which exhibited better establishment and growth also had high shoot and root weights (both fresh and dry). The height of shoots in *L. sativus* remained unaffected even at 12 dS/m, however, the length of roots showed reduction at salinities of more than 9 dS/m.



Experimental set up for mass screening of halophytes



Plans 2003

Evaluation of salt tolerance between accessions within species and between species will continue. This will establish screening levels for larger scale experiments, that is, testing more accessions at a single discriminating level of salinity.

Project PMS12 Water use and salt balance of halophytic species

Duration: Ongoing
Collaborators: N/a
Funding: ICBA

Background

The aim of the study on water use and salt balance in halophytes is to determine the effects of water quality and quantity, harvest period and frequency for optimizing productivity, and to assess the nutritional aspects of test species.

Water use and salt balance experimental set up for *Salvadora persica* (top) and *Haloxylon salicornium* (bottom)

This study simulates the condition in which salt movement takes place under irrigated conditions in fields. The growth of roots and their ability to restrict salt entry, the active and/or passive movements of salts through the root-shoot interface, and the translocation of salt to aerial parts also determine the accumulation of salts in different parts of the soil profile.

Progress 2002

In 2002, two test species; *Salvadora persica* and *Haloxylon salicornicum* were studied.

Measurements of plant height and the volume and salinity of drainage water were recorded for both *Salvadora persica* and *Haloxylon salicornicum*. All plants of *Salvadora persica* were harvested and the biomass of leaf, stem and root recorded. The complete data set provides information on salt transportation and salt water balance. Similar studies were initiated in 2002 on *H. salicornicum*, a halophyte, which exhibits a different mechanism of salt transport. The aim is to compare different species that have differing mechanisms of salt tolerance and hence salt-movements in soil and plant parts.

Results

The height of *S. persica* remained unaffected at different salinity treatments and ET levels (Figure 20).

Seasonal variation in the volume of drainage water did not exhibit any significant differences between salinity treatments. However, at high water application (ET_0 x 1.5), the volume of water increased between September and December as

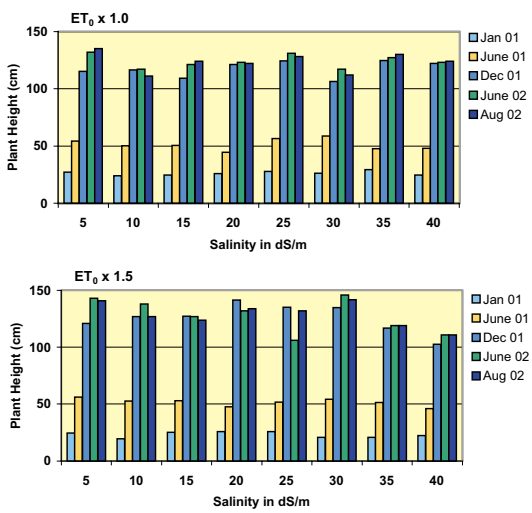


Figure 20 Height of *S. persica* at ET_0 x 1.0 and ET_0 x 1.5 and salinity 5-40 dS/m

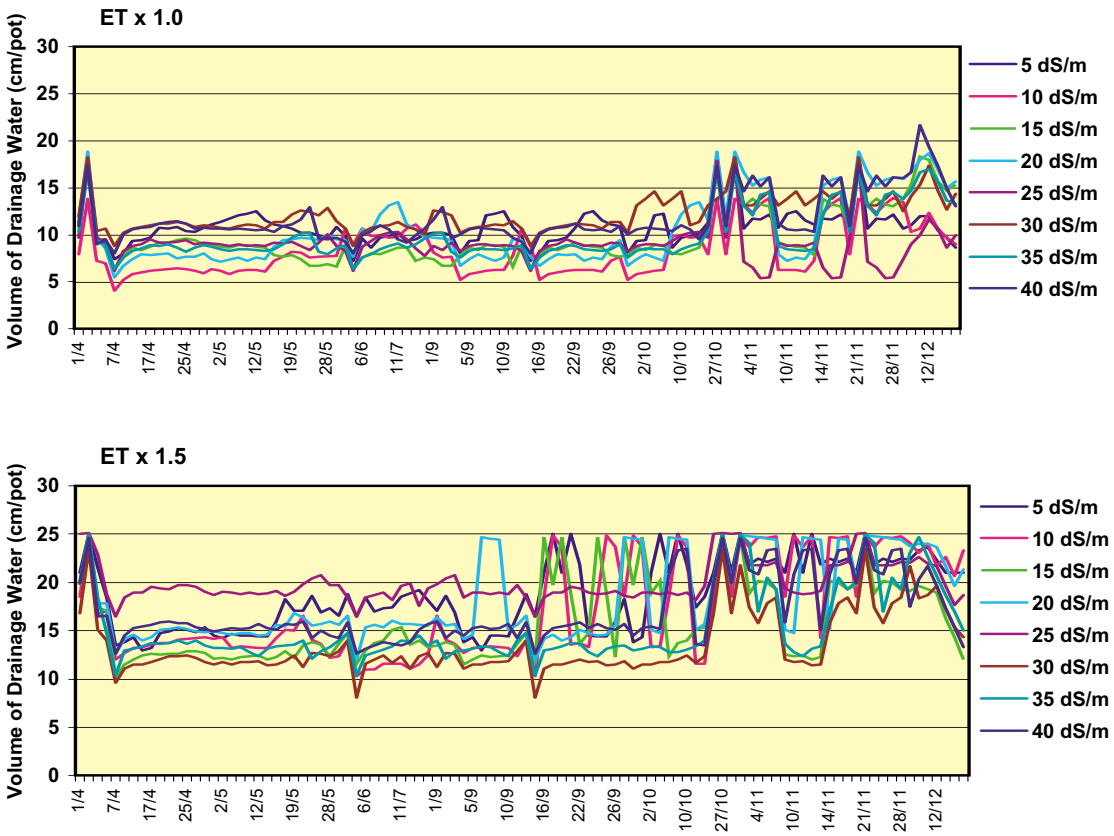


Figure 21 Seasonal variation in the volume of drainage water

a result of relatively less evaporation and higher soil saturation (Figure 21).

Plants harvested after one year showed a relatively higher proportion of root dry mass as compared to shoot (both leaves and stem) in the case of ET_0 x 1.0, indicating less salt entry and consequently better root growth.

As a result, both leaf and stem growth, and dry biomass, remained unaffected at 10-40 dS/m (Figure 22). Application of water at ET_0 x 1.5 increased the dry biomass significantly at low salinity (5 dS/m) as compared to ET_0 x 1.0 treatment. Stem and leaf weight also increased at all salinity levels at ET_0 x 1.5 water application treatment.

Soil salinity was measured periodically at two soil profile depths. As the volume of soil in the experiment is restricted, no significant variation was evident at the two soil depths for most of the salinity treatments (Figure 23). However the overall soil salinity ($EC_{1:5}$) at 40 dS/m saline water treatment was twice as that at 5 dS/m.

Plans 2003

Studies on *Haloxylon salicornicum*, began in late 2002 using the same set-up and salt level treatments. This study will continue for a one-year growth period. Laboratory analyses on plant parts of *Salvadora persica* will also be completed in the first half of the year.

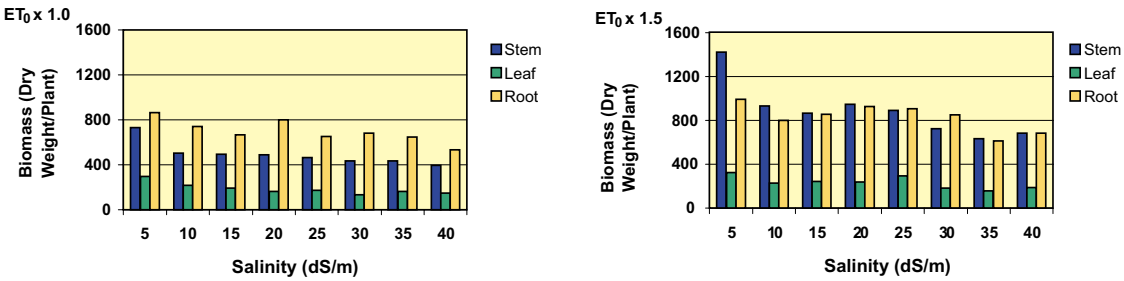


Figure 22 Stem, leaf and root dry biomass of *S. persica* at ET_0 x 1.0, ET_0 x 1.5 and salinity 5-40 dS/m

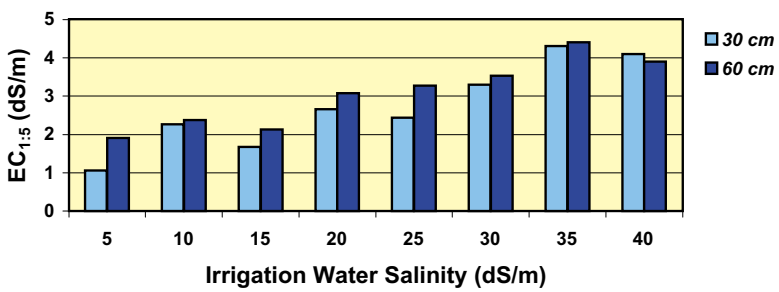


Figure 23 Soil salinity at 30 cm and 60 cm at 5-40 dS/m

Project PMS13 Sustainable utilization of saline groundwater and wastelands for plant production

Duration: 2000-2005
(Extended for 2 years from 2003 to 2005)
Collaborators: International Atomic Energy Agency (IAEA), Ministry of Agriculture and Fisheries (MAF), United Arab Emirates
Funding: ICBA

Background

This study is assessing the potential of salt-tolerant shrubs and trees for forage and fodder, wood production, and ornamental purposes. The experiment began in November 2000 when sixteen indigenous and exotic salt-tolerant test species (Table 4) were established, different establishment techniques being applied for the different species. The survival rate was high. The sixteen species are being irrigated with high salinity water (25 dS/m) and monitored to assess growth rates and productivity.

Progress 2002

In the first one-and-a-half years, data have been collected on the growth and productivity to determine the economic value of the test species.

Plant height was recorded for the shrub and tree species, except for *Atriplex*. In the case of *Atriplex*, shoot volume (height x width x length) and biomass (grazeable leaves and stem above 30 cm) were determined (Table 4). Biomass was harvested at 30 cm from the soil surface and weighed.

Soil salinity for all the species was monitored at critical growth periods, both by measuring electrical conductivity from soil solutions and with an EM-38 soil electrical conductivity meter.

Table 4
Plant height and shoot volume of shrubs and trees irrigated with high salinity water 25 dS/m 2000-2002

Species	Source	Plant height (cm)	Shoot volume (m^3)
Atriplex lentiformis	USDA Acc # SFD-89-F7	92	0.619
Atriplex canescens	USDA Acc # SFD-9-F2	64	0.364
Atriplex undulata	Western Australia	74	1.032
Atriplex nummularia	Western Australia	98	0.440
Sesbania aculeata	International Atomic Energy Agency	318	N/a
Kochia indica	International Atomic Energy Agency	92	N/a
Acacia nilotica	International Atomic Energy Agency	99	N/a
Leucaena leucocephala	Pakistan	203	N/a
Acacia ampliceps	Pakistan	305	N/a
Haloxylon salicornicum	Pakistan	55	N/a
Salvadora persica	Local	104	N/a
Casuarina obesa	CSIRO, Australia	134	N/a
Casuarina glauca	CSIRO, Australia	97	N/a
Casuarina cristata	CSIRO, Australia	65	N/a
Sesbania formosa	CSIRO, Australia	115	N/a

N/a Not applicable

Results

Growth (shoot volume)

The four *Atriplex* species showed variations in growth patterns because of different growth habits: *A. nummularia* and *A. lentiformis* are woody species whereas *A. canescens* and *A. undulata* are shrubs. Measurement of *A. nummularia* and *A. undulata* began in November (week 12) and of *A. canescens* and *A. lentiformis* in late December (week 21). All the species showed increasing shoot volume with time (Figure 24). Shoot volume is a measure of growth and correlates well with productivity for many species.

Growth of salt-tolerant plants under high salinity conditions

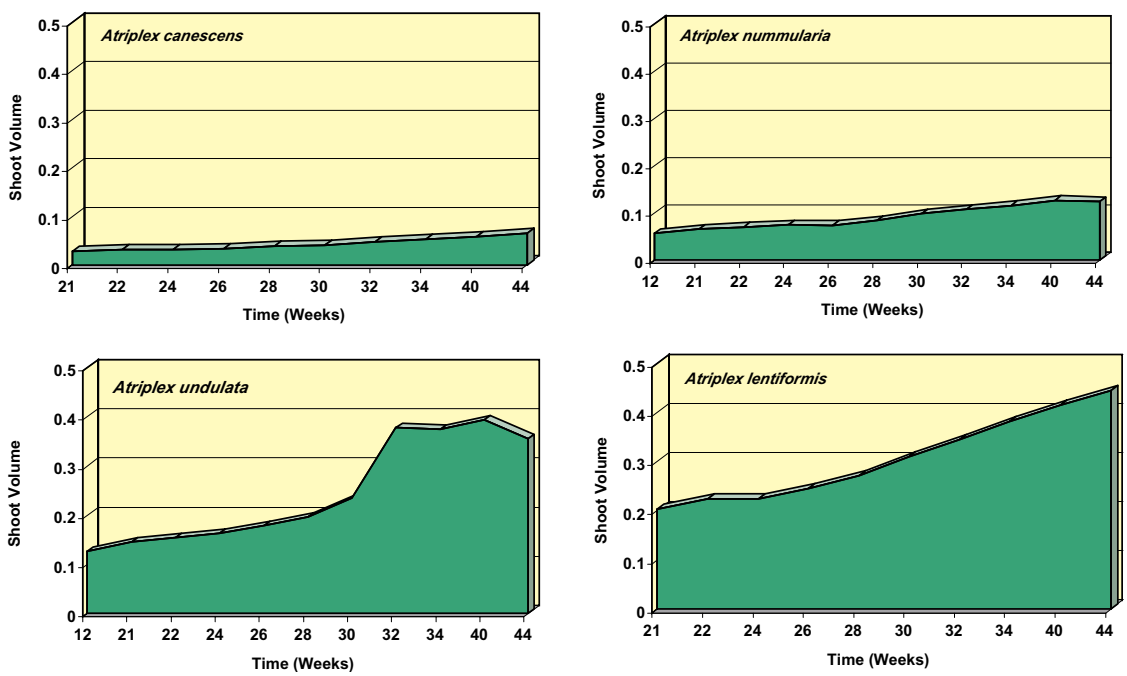


Figure 24 Shoot volume (height x width x length) of two woody species (*A. nummularia* and *A. lentiformis*) and two shrub species (*A. canescens* and *A. undulata*) of *Atriplex* grown at 25 dS/m from November (week 12) and late December (week 21)

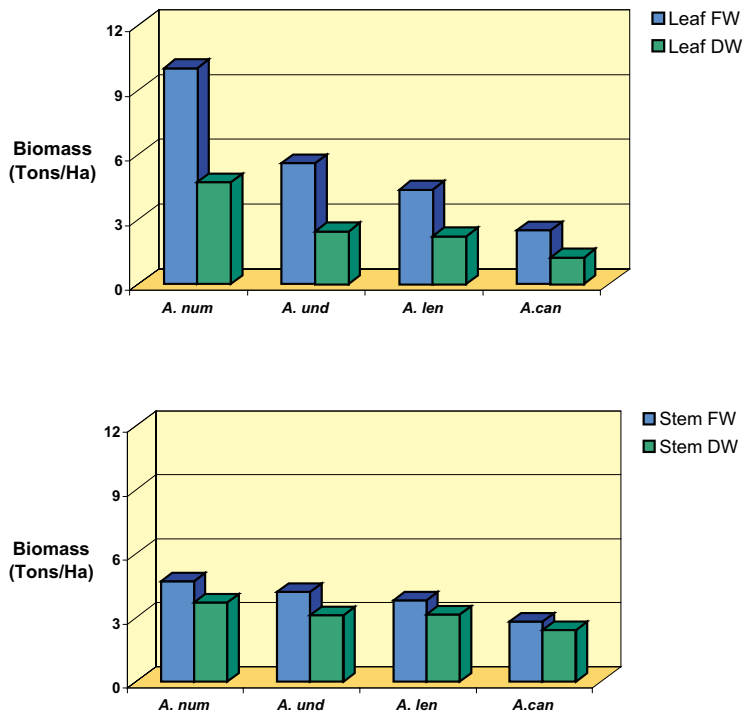


Figure 25 Biomass (grazeable leaf and stem above 30 cm) of four species of *Atriplex* grown at 25 dS/m

Biomass

Of the four *Atriplex* species, *A. nummularia* exhibited the highest biomass and a higher proportion of fresh weight foliage to fresh weight woody stem than the other three species (Figure 25). *A. canescens*, showed an equal proportion of fresh weight stem and leaves. *A. undulata* exhibited higher biomass than *A. canescens*. Although data for both leaf and stem of *A. undulata* and *A. canescens* have been collected separately, the stems are equally important as the leaves for animal feed.

A. nummularia is the most promising of the four species in terms of grazeable biomass.

Soil salinity

Soil salinity, monitored by measuring the extract from soil samples and with an EM-38 soil electrical conductivity meter, showed that $EC_e < EC_{iw}$ and that soil salinity was reasonably controlled after one-and-a-half years, even when irrigated with water of 25 dS/m.

Both the $EC_{1:5}$ values and EM-38 soil electrical conductivity meter values of first-year data for *A. lentiformis* and *A. nilotica* were minimal. On the other hand *Sesbania aculeata* exhibited relatively higher $EC_{1:5}$ and predicted EC_e values. *Acacia ampliceps* appears to be a potentially useful species as minimum salt accumulation occurred in its rhizosphere.

Monitoring of the groundwater in this field test was initiated with the cooperation of an International Atomic Energy Agency (IAEA) consultant during 2002. Preliminary results indicate that the source of groundwater is surface water which has undergone marked evaporation. The preliminary results are inconclusive and a second sampling will be conducted in the near future to determine temporal variations.

Plans 2003

In 2003, other indigenous and exotic salt tolerant species that can be grown under high salinity conditions and have an economic value will continue to be introduced. Species that prove successful will be tested under saline conditions on a farm in Ras Al Khaimah, in collaboration with the UAE Ministry of Agriculture and Fisheries.

Project PMS14 Increasing biodiversity of mangrove species in the UAE: introduction and adaptation of new species

Duration: 2001-2003
Collaborators: Environmental Research and Wildlife Development Agency (ERWDA), United Arab Emirates
Funding: ICBA, ERWDA

Background

Given the large population centers along the coast of the Arabian peninsula, there are considerable opportunities for using mangroves for coastal greening. This project aims to introduce and evaluate introduced mangrove species under UAE environmental conditions.

Progress 2002

Three introduced species, *Rhizophora mucronata*, *Rhizosphora stylosa* and *Ceriops tagal*, from Japan and Pakistan are being evaluated at a range of salinity (5-50 dS/m). Growth and physiology of the test species were monitored in addition to soil and water characteristics. Seasonal variation in salt-water balance studies for these species were completed.

Plans 2003

In 2003 studies of other test species and management practices will be undertaken to quantify the salt movement inside and outside the plants.

Water balance studies in mangroves from Japan and Pakistan

About the Program

The Communication, Information Management and Networking Program gathers, stores, synthesizes and disseminates information on biosaline agriculture through an interactive global network of scientific organizations and individuals.

Objective

The overall objective of the Program is to promote the exchange of information and experience among those involved in biosaline agriculture research and development in the region and throughout the world. It also informs key audiences, donors and potential donors, policy makers, scientific collaborators, extension agents and potential users, scientists and the general public about research, training and information activities of the Center and its partners. By increasing awareness of the Center and by establishing international networks in biosaline agriculture, the Program aims to promote collaborative projects between the Center and other agencies involved in biosaline agriculture research and development and to encourage continued and increasing donor support.

Background

Progress towards solutions to farmers' and producers' problems is best achieved through linking the efforts of those involved in biosaline agriculture. Thus, this Program is working to establish a strong capability for acquiring, storing, updating, retrieving, and disseminating information and knowledge on biosaline agriculture, and for networking, communicating and sharing information with relevant regional, national, and international research institutions.

In the next few years, a bibliographic database of the growing collection of printed and electronic material in the ICBA library will be developed and will be shared electronically on the Center's website. Gradually, as ICBA's collaboration with national, regional and international agencies expands, the Global Biosaline Network and Inter-Islamic Network on Biosaline Agriculture will become critical mechanisms for exchanging and sharing information on biosaline agriculture.

Networks, both human and electronic, support a culture of dialogue between practitioners, stakeholders and other change agents. Networks are also essential to sustain the growth of and linkages between institutions and individuals as well as to encourage learning. Moreover, networks help understanding of the information and communication needs of stakeholders and encourage their involvement.

Communication, Information Management and Networking Program

Communication

Communication at ICBA serves a broad range of audiences. However, key among these are donors and potential donors, policy makers, scientific collaborators, extension agents and potential end-users, peer group scientists and the general public. ICBA produces communications targeted at each of these client groups.

Publications

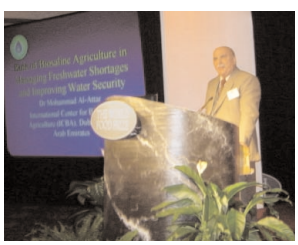
In 2002, the ICBA Strategic Plan 2000-2004 in English was reprinted and also published in Arabic. The ICBA Annual Report 2001 in English, Arabic and French, communicated results and progress in ICBA's program, and presented financial reports to around 1,500 donors, potential donors, partner organizations, government policy makers, senior management in collaborating organizations and organizations which are potential collaborators. Two issues of the ICBA newsletter, Biosalinity News were published in English, French and Arabic and distributed to a mailing list of 1,600 recipients.

Conferences and meetings

ICBA's management and staff attended, participated and made presentations at conferences and meetings throughout the year (Appendix 3). In recognition of ICBA's international role in biosaline agriculture, the Director General was invited as a guest speaker at the World Food Prize International Symposium 'From the Middle East to the Middle West: Managing Freshwater Shortages and Regional Water Security' Des Moines, Iowa, USA, 24-25 October 2002.

In October 2002, ICBA was also requested by the World Bank to co-organize a special session on non-conventional water resources at the Third World Water Forum planned for 15-23 March, 2003, in Kyoto, Japan.

ICBA Seminar at the IDB Governors meeting, Burkina Faso, October 2002



Dr. M. Al-Attar, Director General, addressing the World Food Prize Symposium, Des Moines, USA, October 2002

Communication, Information Management and Networking Program

Public Awaremess

To increase awareness of the ICBA in its host country the UAE, and internationally, the Center participated with publications, posters, videos and plant samples in events attended by policy makers, scientific collaborators, local, national and regional institutions, government representatives and the general public (Table 5).

Media Relations

As a result of press releases, publications and interviews with ICBA management and scientists ICBA activities were widely covered in the UAE and regional media, promoting awareness of the Center's role and activities.

Host country relations

A Government Relations Office was opened in Abu Dhabi in July. The objective of this Liaison Office is to promote continuous communication with government and semi-government bodies, both local and federal, in the host country and later in other GCC countries. This will also include the embassies of the Islamic countries and international organizations to create awareness about the Center and its achievements, and increase cooperation between the Center and these establishments, countries and organizations.

Formal linkages

ICBA signed four Memoranda of Understanding with international and national organizations in 2002 (Table 6)

Linkages and Networks

Many centers around the world have conducted and are conducting research in fields related to biosaline agriculture. However, these efforts are generally conducted in isolation of each other. ICBA is developing networks among those involved in research on biosaline agriculture to focus and align efforts to address common problems occurring across regions and countries.

Linkages

ICBA's linkages and relationship building with many individuals, donors and organizations have resulted in development of collaborative adaptive trials projects for the delivery of biosalinity technology with the Sultanate of Oman, Saudi Arabia, United Arab Emirates, and with international agencies such as the International Fund for Agricultural Development (IFAD), the International Atomic Energy Agency (IAEA), the OPEC Fund for International Development and the Arab Fund for Economic and Social Development (AFESD). The work covers many facets of biosaline agriculture including:

Table 5 ICBA participation in exhibitions 2002

Event	Date	Location
Water & Energy Technology and Environment Exhibition(WETEX 2002)	February 2002	Dubai, UAE
4th Gulf Water and Environment Week	March 2002	Sharjah, UAE
2nd International Symposium on Scientific Research and Technology Development in the Arab World	March 2002	Sharjah, UAE
Al Ain Flower Show and Festival	March-April 2002	Al Ain, UAE
AOAD Arab Agriculture Ministers Meeting	April 2002	Abu Dhabi, UAE
Consultative Group on International Agriculture Annual Meeting	October 2002	Manila, Philippines
Islamic Development Bank Annual Meeting	October 2002	Ouagodoguo, Burkina Faso
Group 77 High-level Conference on Science and Technology	October 2002	Dubai, UAE

Signing of the Memorandum of Understanding with the International Atomic Energy Agency (left) and FAO (right).

Table 6
Memoranda of Understanding 2002

Organization	Date
Food and Agriculture Organization (FAO)	February 2002
International Atomic Energy Agency (IAEA)	March 2002
Bangladesh Agricultural Research Institute (BARI), Bangladesh	March 2002
United Arab Emirates University (UAEU)	November 2002

- Use of process saline water and demonstrating biosaline agriculture PDO Oman
- Reclaiming salt-affected areas and managing salinity and water logging UAE
- DNA fingerprinting for salt-tolerance Saudi Arabia
- Assessment of saline water resources West Asia and North Africa
- Demonstration farm Ras Al Khaimah
- Increasing biodiversity of mangrove species UAE.

Networks

As part of its mission to synthesize and disseminate information on biosaline agriculture, ICBA hosts the Global Biosaline Network and Inter-Islamic Network on Biosaline Agriculture. These networks will facilitate exchange of information, skills, knowledge, experiences, materials, and media through meetings, workshops, publications, and cooperative programs. The networks will lead to less duplication of work and effort and link people of different levels, disciplines, organizations and backgrounds who would not otherwise have opportunity to interact. In addition, the networks will create an awareness that others have similar concerns and developmental problems and provide a critical mass needed for action, helping to address complex problems and issues that may seem overwhelming to those working on only one level.

Inter-Islamic Network on Biosaline Agriculture (INBA)

At the COMSTECH meeting in Islamabad in February 2002, the Executive Committee and General Body of COMSTECH approved the establishment of the Inter-Islamic Network on Biosaline Agriculture (INBA) and asked ICBA to host the new network. ICBA will coordinate the network and promote exchange of information and experience among those involved in saline agriculture research, development, and training.

In 2003 there will be a membership drive and a steering committee will be formed.

Communication, Information Management and Networking Program

Dr. Al-Attar addressing the COMSTECH meeting (left) Meeting of Executive Directors of Inter-Islamic Networks at ICBA (right)

Global Biosaline Network (GBN)

The web-based Global Biosaline Network hosts a data bank of professionals involved in biosaline agriculture. At the end of 2002, the network had 151 registered members from 45 countries (Figure 26). With funds provided by the OPEC Fund the network now provides on-line information resources on biosaline agriculture, such as the comprehensive on-line agricultural research bibliographic databases Agricola, AGRIS and CABCD.

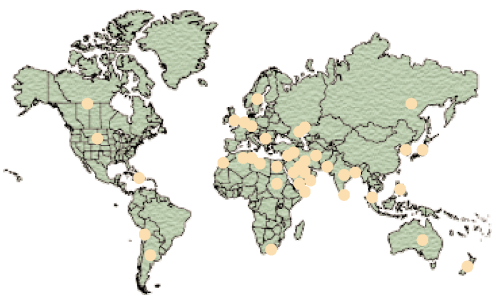


Figure 26 Membership of Global Biosaline Network

H.E. Dr. Khalifah Al-Mahjoub, Minister of Agriculture and Forests, Sudan, on a tour of ICBA's facilities

H.E. Dr. Abdoulla Ben Abdoul Aziz Ben Mo'ammar, Minister of Agriculture and Water, Saudi Arabia, visiting ICBA

Visitors

Visits to ICBA were arranged for 7 Ministers, 6 representatives of diplomatic missions, 25 representatives of international organizations, 8

representatives from the Islamic Development Bank and 17 representatives of UAE organizations. Visits led to collaborative activities, the exchange of germplasm and strengthening ICBA's links with other organizations in biosaline agriculture.

Information Management

Information management incorporates gathering, storing, synthesizing and disseminating information on biosaline agriculture.

ICBA Library Services

In 2002, the ICBA library continued to establish a comprehensive collection of printed and electronic material and to provide information services for Center staff, collaborators and members of its networks.

Information resources on salt-tolerant trees, plants, shrubs and groundcover

Library staff began to compile information on salt tolerant plants, shrubs and groundcover. Taxonomic names were confirmed using the International Taxonomic Information System or the International Plant Names Index, and illustrations and descriptions were located on the Internet and in ICBA library materials. Information was complied on 89 species and library staff edited the descriptions, selected appropriate illustrations, designed a report format and prepared a report on each plant.

For each species, a one- to two-page report includes the taxonomic name, common names in Arabic and English, illustrations and a brief description based on the source information. The report was organized into sections by type of plant (Tree, Palm, Shrub, etc.), with a table of contents for each section.

A copy of the report on the 89 species was presented to the Private Office of the President of the UAE and Ruler of Abu Dhabi, at their request.

Work is continuing to compile information on the 500 salt-tolerant plants identified to date and to develop a database.

About the Program

The Training, Workshops and Extension Program addresses the need for professional training of scientists in biosaline agriculture and for effective technology transfer.

Objective

The Program provides training courses for scientists and technicians specializing in the field of biosaline agriculture. The Center also organizes seminars and meetings to exchange information on biosaline agriculture and to identify priority program areas that need to be addressed locally, regionally, and globally.

Background

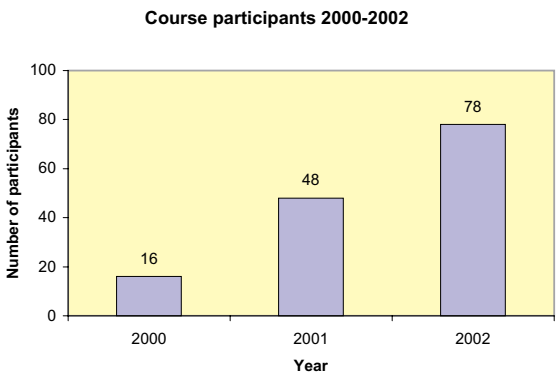
The irrigated agriculture sector has been increasing between 10% and 15% a year for the past 20 years. There are too few trained people working in irrigated agriculture research and development in most parts of the world, and fewer still who are trained in the special skills and techniques of saline irrigation. Training in technical aspects of saline irrigated agriculture is thus a key role for ICBA.

While most training is through collaborative projects, the Center holds training courses at its Training Center and seeks opportunities to conduct training courses in network countries. Post-graduate students are also given opportunities to undertake projects at the Center under the supervision of ICBA scientists.

Training, Workshops and Extension Program

Training Courses

In 2002, three training courses were held at ICBA on irrigation management techniques, sustainable production systems for biosaline agriculture, and agro-ecological surveys and germplasm collection (Table 7). Since 2000, 141 trainees, coming from an increasing number of countries, have attended seven training courses (Figure 27). Funding for the courses in 2002 was provided by IAEA, the OPEC Fund and ICBA.



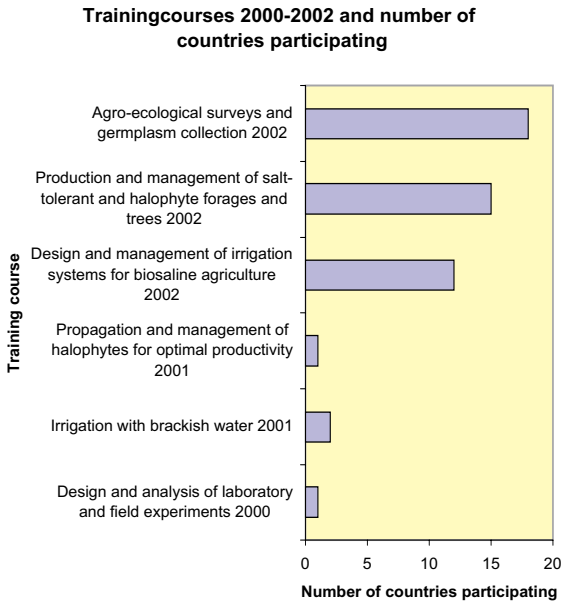


Figure 27 Number of participants at ICBA training courses and number of countries particpating 2000-2002

Design and Management of Irrigation Systems for Biosaline Agriculture, 9-13 March, 2002

Twenty-five participants from 13 countries attended this course and were introduced to the principles of irrigation design for biosaline agriculture. Participants designed their own irrigation systems and assembled these in the field. To enable them to transfer the techniques to their own countries, participants were provided with compact discs of all course materials along with software for calculating water requirements, software for unit conversion and software for irrigation design.

Participants of the three ICBA training courses in 2002

Training, Workshops and Extension Program

Table 7 Participation in ICBA training courses 2002 by country and funding agency

	Courses									
	Irrigation Systems for Biosaline Agriculture			Salt-tolerant and Halophyte Forages and Trees			Agro-ecological Surveys and Germplasm Collection			
	Sponsorship									
Country	OPEC Fund	IAEA	IDB/Self-financed	OPEC Fund	IAEA	Self financed	OPEC Fund	IAEA	Self financed	Total per Country
Azerbaijan	1			1			1			3
Bangaladesh	1			1			1			3
Burkina Faso							1			1
Egypt	1			1	1		1			4
Iran		3			1			2	1	7
Iraq			1			1			1	3
Jordan	1				2		1			4
Kazakhstan							1			1
Lebanon	1			1						2
Malaysia									1	1
Mali							1			1
Mauritania				1						1
Morocco					1					1
Oman			1			4			1	6
Pakistan	1									1
Palestine	1	1					2			4
Saudi Arabia			2						1	3
Senegal	1			1			1			3
Sudan	1		1	1			1		1	5
Syria					1					1
Tunisia				1			1			2
Turkmenistan							1			1
United Arab Emirates			5			7			4	16
Uzbekistan							1			1
Yemen	2									2
Total	11	4	10	8	6	12	14	2	10	77

Production and Management of Salt-Tolerant and Halophyte Forages and Tree Species, 27 April-2 May, 2002

This training course, funded by the IDB, OPEC and IAEA, was attended by 26 participants from 15 countries. Six of the participants from Egypt, Iran, Jordan, Morocco and Syria were sponsored by IAEA, and ICBA supported travel, boarding and lodging for the other participants who came from less-developed IDB member countries.

Agro-ecological Surveys and Germplasm Collection 5-9 October 2002

This training course familiarized participants with the concepts underlying germplasm collection and conservation, the role of agro-ecological surveys in setting priorities, and planning and implementing germplasm collection missions.

Training course participants

Workshops

In 2002, ICBA also organized two workshops on marginal water as part of international conferences in Dubai.

Technical Session on Marginal Waters at the Conference on "Water Management in the Third Millennium", 2-6 February 2002. Dubai, UAE

At the request of the Zayed International Prize for the Environment, ICBA convened a special technical session on "Marginal Waters" at the international conference on Water Management in the Third Millennium, Dubai, 2-6 February 2002. Six international speakers covered irrigation with saline water, biosaline agriculture and treated wastewater. Prof. Faisal Taha, Director Technical Programs, served as Chairman for the session.

One-day workshop on "Sustainable Utilization of Saline Ground Water and Wastelands for Plant Production", 23 March 2002, at ICBA

The International Atomic Energy Agency (IAEA) requested ICBA to organize a one-day workshop to discuss progress on biosaline agriculture. The workshop was held on 23 March 2002 and attended by senior management and technical staff from IAEA, ICBA, the Ministry of Agriculture and Fisheries, Ministry of Water and Electricity, ERWDA, UAE University and Abu Dhabi, Al Ain, Dubai and Sharjah Municipalities.

Graduate M.Sc Program

ICBA hosted an MSc. student studying at the UAE University. The student concluded his research on salinity tolerance of different cultivars of Rhodes grass (*Chloris gayana*) co-supervised by ICBA scientists during 2002.

Infrastructure Development

Training Center and Auditorium

Strengthening national agricultural systems in biosaline agriculture is a fundamental part of ICBA's mission. The completion of ICBA's Training Center and Auditorium in March 2002 enables the Center to provide specialized training to a greater number of trainees than previously.

Construction of a dedicated Training Center and Auditorium began in October 2001 and was completed in February 2002. The new building is approximately 420 square meters and consists of an auditorium, a computer laboratory, a reception area and ancillary facilities. The auditorium and computer laboratory are equipped with advanced audiovisual facilities and accommodate up to 95 and 27 participants respectively. The computer laboratory contains 27 networked computers.

Irrigation system

Expansion

The Arab Fund for Economic and Social Development (AFESD) committed Kuwaiti Dinars 275,000 to complete ICBA's irrigation and drainage facilities on 40 hectares, as initially planned when the Center was set up. The expansion includes a variant salinity irrigation system covering an additional 15 hectares of experimental plots and a seawater experimental facility dedicated to research on seawater halophytes, a lysimeter, for measuring daily evapotranspiration, and extension of the pumping stations.

Specifications and drawings were prepared and offered for tender in September 2002. Contracting implementation will begin in March 2003 and is expected to be completed by January 2004.

Exterior of the training center and auditorium (above) and e-networked training room (below).

Modification

ICBA's existing irrigation system was modified and expanded to accommodate new experimental requirements and the drainage system of experimental plots was serviced to control the water table and allow more effective leaching of salts.

Administration and Finance Services

Highlights

To carry out the goals laid out in the Center's Strategic Research Plan 2000-2004, ICBA embarked on a strong campaign to raise additional funds for the Center. Efforts were successful with commitments for 2003 from AFESD, OPEC, PDO Oman, Abu Dhabi Municipality, BEHAR Saudi Arabia, IAEA, and IFAD. Having established its credibility at this early stage, ICBA is confident that the Center will enjoy strong financial support from donors and organizations for developing sustainable biosaline agriculture in the years to come.

Strengthening the ability of national agricultural systems to undertake innovative and practical problem solving is a fundamental part of ICBA's mission to develop biosaline agriculture. The completion of ICBA's Training Center and Auditorium in March 2002 enables the Center to provide specialized training to a greater number of trainees than previously. Support from OPEC made it possible for trainees from the lesser-developed Islamic Development Bank member countries to attend training courses.

ICBA's administrative and financial policies and procedures reflect international standards of public research centers. In 2002, ICBA continued to develop the financial and administrative mechanisms that have been established to enable the center to achieve its strategic goals.

Administration & Finance Services

Board of Trustees and Board of Directors

Meetings

ICBA's Board of Directors held meetings in May and October 2002. The Board of Directors recommended that ICBA prepare a paper on increases in staff remuneration with respect to cost-of-living and merit increases for submission to the Board of Trustees.

At the request of the Board of Trustees, ICBA prepared a comprehensive report on commercialization of its products and submitted it to IDB. The report concluded that it would not be appropriate for ICBA to be involved in commercialization and that any commercial activities should be undertaken by a company established for such a purpose.

New members of Board of Directors

Two new members joined ICBA's Board of Directors in 2002: Mr. Abdelmajid Slama Director, Near East, North Africa and Europe Division of the International Fund for Agricultural Development (IFAD), and Dr. Fareed Hussain Al Darwish, Assistant Dean for Student Affairs, Faculty of Food Systems, UAE University, Al Ain. Mr. Slama was appointed by the Islamic Development Bank (IDB).

ICBA Board of Directors meeting October 2002

Administration

Fire fighting system

The fire fighting system was checked and tested and repairs were carried out. An annual maintenance contract was signed.

Serially numbered vouchers

The Finance Unit has serially numbered all the Payment and Journal Vouchers. This will enhance internal control and will also facilitate reporting and data retrieval capabilities of the Finance Unit.

Safety manual

Acknowledging the importance of safety in the field as well as in the buildings, the Center contracted the preparation of a safety manual which, once completed, will make ICBA a safer place to work.

Information technology

During 2002, ICBA has been continuously upgrading the computer network and maintaining its website. The Center also acquired and installed hardware and computers in the training center. As part of the project funded by OPEC to establish the Global Salinity Network, a consultant was engaged to assess and make recommendations to enhance the network. The licenses for the software being used in the Center were also renewed and new software was acquired to meet current needs.

Insurance

ICBA appointed a new insurance company for staff medical and life insurance, and insurance of ICBA facilities.

Staff

ICBA bade farewell to Dr. Abdullah Jaradat, Plant Genetic Resources Scientist. Dr. Jaradat joined ICBA in its early stages and played a very active role in the Center's development. ICBA also bade farewell to Mrs. Ann Bostock, the Administrative Assistant in the Technical Programs Division.

Dr. John W. Stenhouse joined ICBA as Plant Genetic Resources Scientist, and Dr. Sandra Child assumed the post of Communications Specialist. Mrs. Jane Roberts joined ICBA as Administrative Assistant, Technical Programs and Eng. Basel Al Araj as Technician, Technical Programs. The Computer Supervisor and IT Specialist, Mr. Ghassan El Eid, joined ICBA towards the end of 2002.

Employee capacity building

To improve the employees' capabilities, effectiveness and efficiency, ICBA staff attended courses as shown in Table 8.

Resource Mobilization

To carry out the goals laid out in the Center's Strategic Research Plan 2000-2004, ICBA embarked on a strong campaign to raise additional funds for the Center. Efforts were successful with commitments for 2003 from the Arab Fund for Social and Economic Development (AFESD), the OPEC Fund for International Development, Petroleum Development Oman (PDO), Arabian Saline Water Technology Company (BEHAR) Saudi Arabia, International Atomic Energy Agency (IAEA), and the International Fund for Agricultural Development (IFAD). Having established its credibility at this early stage, ICBA is confident that the Center will enjoy strong financial support from donors and organizations for developing sustainable biosaline agriculture in the years to come.

OPEC Fund for International Development support for training and networking

Approved by the OPEC Fund in 2001, the $200,000 grant for two years (2002-2003), was received by ICBA early in the year 2002 enabling participation of a larger number of trainees in ICBA's three scheduled courses in 2002. The grant supported the travel and costs of participation of trainees from least developed member countries of the Islamic Development Bank. The participants that benefited from the grant came from Azerbaijan, Bangladesh, Burkina Faso, Egypt, Jordan, Kazakhstan, Lebanon, Mali, Mauritania, Morocco, Pakistan, Palestine, Senegal, Sudan, Syria, Tunisia, Turkmenistan, Uzbekistan, and Yemen. Earlier training courses had only benefited Gulf Cooperation Council country participants who were sponsored by their employers.

The grant also enabled ICBA to strengthen its web-based Global Biosaline Network.

Table 8 Staff training courses 2002

Program	Course Title
Technical Programs	Advanced Negotiation Skills
Technical Programs	Project Management Skills
Technical Programs	DNA Finger Printing
Technical Programs	Advanced Lab Analyses
Technical Programs	Advanced Irrigation and Modelling
Office of the Director General	Self & Time Management
Administration and Finance	Advanced Interviewing
Administration and Finance	Safety and Loss Prevention
Administration and Finance	Performance Measurement and Benchmarking
Administration and Finance	Effective Budgeing and Cost Control

Administration & Finance Services

Arab Fund grant for completing the irrigation facilities at ICBA

The irrigation system at ICBA, initially installed in 1999 with funds from the Islamic Development Bank and the OPEC Fund for International Development, rapidly became inadequate for ICBA's expanding requirements for field trials and the increasing number of collaborative projects. In 2002, the Arab Fund for Economic and Social Development approved ICBA's proposal seeking $900,000 to complete ICBA's irrigation and drainage facilities on 40 hectares, as initially planned when the Center was set up. With these funds, the Center's irrigation system is expected to be completed by mid-2003. The enhanced system will provide the necessary infrastructure for ICBA's scientists to conduct experiments requiring precise levels of salinity in the irrigation water and efficient drainage, with state-of-the-art remote controls.

IFAD assessment of saline water resources in seven countries

The United Nations agency based in Rome, the International Fund for Agricultural Development (IFAD), provided its first grant to ICBA in 2002. The $32,000 grant was provided to assess the saline water resources in Algeria, Jordan, Libya, Oman, Syria, Tunisia, and Yemen. The assessment will be completed by February 2003 and the final report is expected to leverage a multi-million dollar proposal from ICBA to the same donor for co-financing ICBA's future activities in West Asia and North Africa.

Support for training in Central Asia

Noting the catastrophic problem of salinity in Central Asia, ICBA and the International Center for Agricultural Research in the Dry Areas (ICARDA) will hold a training course on biosaline agriculture in Tashkent, Uzbekistan in 11-21 May 2003. The Private Office of His Highness the President of United Arab Emirates indicated that it would co-sponsor the event and provide US$20,000 to complement funds from other co-sponsors. ICBA has sought support for the event from international donors such as the Department for International Development (DFID), UK and the Asian Development Bank. DFID informally indicated its willingness to partially support the event in 2003.

Private sector support

The private sector firm Petroleum Development Oman awarded a US$195,000 grant towards implementing projects to utilize saline ("process") water that is extracted with oil and is currently unutilized. This grant provides opportunities to undertake projects that will add up to US$258,000 when completed. This support complements the existing private sector support from M/s BEHAR, Saudi Arabia, that began in 2001.

Public sector contracts for outreach projects in the UAE

The Sewerage Projects Committee of the Emirate of Abu Dhabi awarded a consultancy to ICBA to conduct investigative research on the extent of salinity resulting from water logging in important farm areas of the Emirate. The consultancy is expected to provide ICBA US$112,000 over four separate segments, each providing ICBA with US$28,000.

COMSTECH support for INBA

In February 2002, the Executive Committee and General Body of the Committee for Science and Technology (COMSTECH) of the Organization of Islamic Countries announced support of up to $50,000 to ICBA to set up a web-based Inter-

Islamic Network on Biosaline Agriculture (INBA). The new network will focus and align efforts to address common problems in biosaline agriculture occurring across Islamic countries and regions.

Measures to secure core funds

In efforts to attract core financial support from the Arab Funds, the Gulf Cooperation Council (GCC) countries and the host country, the United Arab Emirates (UAE), ICBA opened a Government Relations Office in Abu Dhabi, UAE. This liaison office will promote awareness of ICBA, with government and semi-government bodies, both local and federal, in the host country and later in the GCC countries. The public awareness thrust will target the embassies of the Islamic countries and offices of international organizations located in Abu Dhabi.

New thrusts to procure funds

Encouraged by the high success rate of ICBA's proposals to donors, ICBA focused its attention during the year on developing mega-proposals involving several donors and benefiting several countries. Several donor representatives visited ICBA during the year and left convinced that ICBA could implement major regional projects.

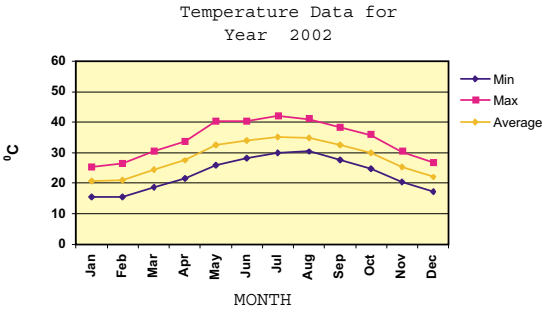
ICBA's senior staff followed up with strategic visits to certain donors and national agricultural research headquarters that will play major roles in future research projects. ICBA staff work diligently to be active partners in the challenge programs of the Consultative Group on International Agricultural Research (CGIAR), which will add to ICBA's financial resources and improve its visibility within the scientific community.

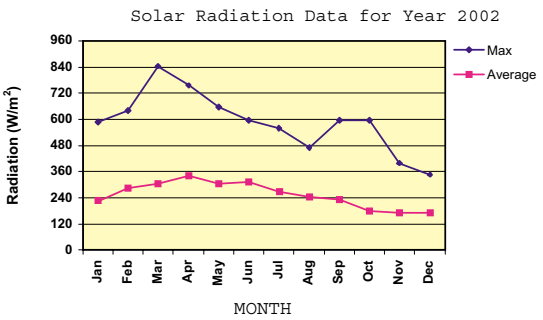
Appendixes

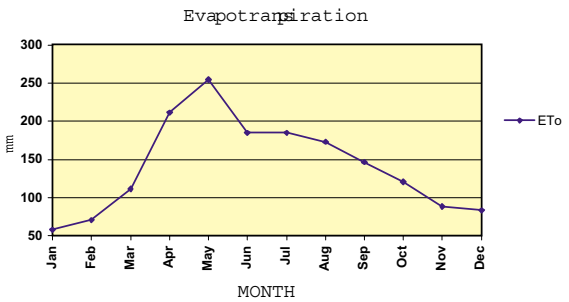
Appendix 1 Summary of ICBA's genebank holdings (December 2002)

Serial No.	Genus	Family	No. of accessions	No. of species	Nature of Crop
1	*Agropyron*	Gramineae	1	1	Forage
2	*Arachis*	Fabaceae	9	1	Oilseed/forage
3	*Asphodelus*	Asphodelaceae (Liliaceae)	2	1	Forage
4	*Astragalus*	Fabaceae	70	23	Forage
5	*Atriplex*	Chenopodiaceae	42	9	Forage
6	*Avena*	Gramineae	1	1	Forage/grain
7	*Beta*	Chenopodiaceae	50	1	Forage
8	*Cajanus*	Fabaceae	71	1	Forage
9	*Calligonum*	Polygonaceae	3	2	Forage
10	*Carthamus*	Asteraceae	641	2	Oilseed
11	*Cassia*	Caesalpiniaceae	1	1	Forage
12	*Cenchrus*	Gramineae	868	1	Forage
13	*Centrosema*	Fabaceae	1	1	Forage
14	*Chenopodium*	Chenopodiaceae	121	1	Forage
15	*Chloris*	Gramineae	116	1	Forage
16	*Clitoria*	Fabaceae	1	1	Forage
17	*Coelachyrum*	Gramineae	1	1	Forage
18	*Crotalaria*	Fabaceae	5	1	Forage
19	*Cyperus*	Cyperaceae	2	1	Forage
20	*Dichanthium*	Gramineae	11	1	Forage
21	*Digitaria*	Gramineae	1	1	Forage
22	*Dipterygium*	Capparidaceae	8	1	Forage
23	*Echinochloa*	Gramineae	145	9	Forage
24	*Farsetia*	Brassicaceae	2	1	Forage
25	*Haloxylon*	Chenopodiaceae	1	1	Forage
26	*Hedysarum*	Fabaceae	16	5	Forage
27	*Heliotropium*	Boraginaceae	3	1	Forage
28	*Hordeum*	Gramineae	12	1	Forage/grain
29	*Hymenocarpos*	Fabaceae	2	1	Forage
30	*Indigofera*	Fabaceae	5	2	Forage
31	*Jaubertia*	Rubiaceae	2	1	Forage
32	*Lablab*	Fabaceae	44	1	Forage
33	*Lasiurus*	Gramineae	9	1	Forage
34	*Lathyrus*	Fabaceae	254	3	Forage
35	*Leptochloa*	Gramineae	3	1	Forage
36	*Leucaena*	Mimosaceae	237	1	Forage
37	*Lotus*	Fabaceae	446	21	Forage
38	*Lupinus*	Fabaceae	264	18	Forage
39	*Lycium*	Solanaceae	1	1	Forage
40	*Maireana*	Chenopodiaceae	1	1	Forage
41	*Medicago*	Fabaceae	509	40	Forage
42	*Melilotus*	Fabaceae	481	2	Forage
43	*Ochradenus*	Resedaceae	5	2	Forage
44	*Oryzopsis*	Gramineae	1	1	Forage
45	*Panicum*	Gramineae	26	2	Forage
46	*Paspalum*	Gramineae	3	2	Forage
47	*Pennisetum*	Gramineae	147	4	Forage
48	*Phalaris*	Gramineae	1	1	Forage
49	*Prosopis*	Mimosaceae	2	2	Forage
50	*Rhanterium*	Asteraceae	2	1	Forage
51	*Scorpiurus*	Fabaceae	19	1	Forage
52	*Simmondsia*	Simmondsiaceae (Buxaceae)	29	1	Oilseed
53	*Sorghum*	Gramineae	447	4	Forage/grain
54	*Sphaerocoma*	Caryophyllaceae (Illecebraceae)	2	1	Forage
55	*Sporobolus*	Gramineae	77	18	Forage
56	*Stipagrostis*	Gramineae	22	2	Forage
57	*Stylosanthes*	Fabaceae	2	2	Forage
58	*Tephrosia*	Fabaceae	1	1	Forage
59	*Trifolium*	Fabaceae	155	17	Forage
60	*Trigonella*	Fabaceae	13	1	Forage
61	*TRITICALE*	Gramineae	936	1	Forage/grain
62	*Triticum*	Gramineae	59	1	Forage/grain
63	*Urochloa*	Gramineae	1	1	Forage
64	*Vicia*	Fabaceae	11	1	Forage
65	*Vigna*	Fabaceae	408	1	Forage/grain
66	*Ziziphus*	Rhamnaceae	2	1	Forage
		Total	**6,752**	**209**	

Appendix 2 Summary of weather data from Dubai Airport







Month	Temperature (°C)				Relative Humidity (%)				Sun Shine	Solar Radiation (W/m²)			Windspeed (Km/hr)				Rainfall (mm)		ETo (mm)	
	Min	Max	Av	Med	Min	Max	Av	Med	Hrs	Max	Av	Med	Min	Max	Av	Med	Total	Total to Date	Monthly	Total to Date
Jan	15.5	25.2	20.7	20.4	34.0	77.0	55.0	55.5	8.3	586.0	224.5	275.0	7.0	32.0	14.0	19.5	3.8	3.8	58.4	57.8
Feb	15.4	26.4	21.0	20.9	35.0	80.0	56.0	57.5	9.1	639.0	282.7	302.0	7.0	30.0	14.0	18.5	0.6	4.4	70.5	128.9
Mar	18.6	30.4	24.5	24.5	28.0	82.0	57.0	55.0	9.6	844.0	304.2	351.0	6.0	44.0	15.0	25.0	24.4	28.8	111.3	240.2
Apr	21.6	33.6	27.5	27.6	23.0	75.0	50.0	49.0	10.6	755.0	340.1	404.0	8.0	33.0	17.0	20.5	0.6	29.4	223.0	463.2
May	25.9	40.2	32.6	33.1	16.0	70.0	44.0	43.0	11.1	657.0	304.5	337.0	7.0	32.0	16.0	19.5	1.1	30.5	262.0	725.2
Jun	28.3	40.3	34.0	34.3	23.0	76.0	52.0	49.5	11.2	595.0	312.7	337.0	7.0	32.0	16.0	19.5	0.0	30.5	205.0	930.2
Jul	29.9	42.0	35.1	36.0	21.0	78.0	53.0	49.5	11.1	559.0	265.8	298.0	7.0	31.0	15.0	19.0	0.0	30.5	185.0	1115.2
Aug	30.4	41.0	34.9	35.7	28.0	77.0	56.0	52.5	10.7	470.0	241.9	266.0	7.0	36.0	16.0	21.5	Tr.	30.5	173.1	1288.3
Sep	27.7	38.2	32.5	33.0	29.0	83.0	60.0	56.0	10.3	595.0	231.3	248.0	6.0	30.0	15.0	18.0	0.0	30.5	146.6	1434.9
Oct	24.8	35.8	30.0	30.3	27.0	85.0	60.0	56.0	9.5	595.0	177.5	257.0	6.0	31.0	14.0	18.5	0.0	30.5	120.3	1555.2
Nov	20.3	30.3	25.4	25.3	32.0	75.0	54.0	53.5	8.9	399.0	170.5	205.0	6.0	32.0	14.0	19.0	Tr	30.5	88.4	1643.6
Dec	17.2	26.8	22.0	22.0	35.0	77.0	57.0	56.0	8.2	346.0	169.7	201.0	6.0	33.0	14.0	19.5	4.0	34.5	83.3	1726.9
Av	23.0	34.2	28.4	28.6	27.6	77.9	54.5	52.8	9.9	586.7	252.1	290.1	6.7	33.0	15.0	19.8				

Appendix 3 Publications, presentations and meetings 2002

Published by ICBA

Biosalinity News. Newsletter of the International Center for Biosaline Agriculture. Vol. 3. No. 1. 2002. English, Arabic, French.

Biosalinity News. Newsletter of the International Center for Biosaline Agriculture. Vol. 3. No. 2. 2002. English, Arabic, French.

ICBA Annual Report 2001 (1421/1422H). English, Arabic, French.

ICBA Strategic Plan 2000-2004. English and Arabic. (Reprint)

Refered publications

Ahmad, R. and S. Ismail. 2002. Demonstration of Biosaline Agriculture for fodder production. In: Prospects for Saline Agriculture (Ahmad, R. and K.A. Malik, eds.), pp. 415-422, Kluwer Acad. Publ., Netherlands.

Gul, H., Ahmad, R. and S. Ismail. 2002. Comparative performance of different canola varieties under various salinity regimes. In: Prospects for Saline Agriculture (Ahmad, R. and K.A. Malik, eds.), pp. 251-260, Kluwer Acad. Publ., Netherlands.

Roomi, D.H., Ahmad, R., Ismail, S. and A. Ghaffar. 2002. Effect of salt stress on Rhizobium and growth of Acacia ampliceps. In: Prospects for Saline Agriculture (Ahmad, R. and K.A. Malik, eds.), pp. 297-308, Kluwer Acad. Publ., Netherlands.

Technical publications

Taha, F. and J. Abraham. 2002. ICBA--An International Research Centre devoted to growing plants with salty water on marginal lands –a profile. Pages 8-11, APAARI Newsletter, 2002.

Papers presented

Al-Attar, M.H. 2002. Role of Biosaline Agriculture in Managing Freshwater Shortages and Improving Water Security. Paper presented at World Food Prize Symposium 'From Middle East To Middle West: Managing Freshwater Shortages and Regional Water Security,' Des Moines, USA, October 24-25, 2002.

Al-Attar, M.H., F.K. Taha, and J. Abraham. 2002. Role of The International Center For Biosaline Agriculture (ICBA) in Assisting Developing Countries to Combat Salinization and Develop Biosaline Agriculture. Paper presented at the "International Symposium on Optimum Resources Utilization in Salt-Affected Ecosystems in Arid and Semi-Arid Regions", Desert Research Center, Cairo, Egypt, 8-11 April, 2002.

Dakheel, A.J. and F.K. Taha. 2002. The Potential Roles of Public-Private Partnership in Promoting Biosaline Agriculture in MENA Region. Paper presented at the "Workshop on public-private partnership in the water sector for the Middle East and North African countries", November 1-3, 2002. Cairo, Egypt. Organized by the German Federal Ministry for Economic Cooperation and Development and Third World Centre for Water Management Mexico.

Dakheel, A.J. and F.K. Taha. 2002. The use of saline water in agricultural production and its increasing importance in the MENA region. Paper presented at Workshop on "Critical Emerging Water Issues for the Middle East and North African Countries", November 1-3, 2002. Cairo, Egypt. Organized by the German Federal Ministry for Economic Cooperation and Development and Third World Centre for Water Management Mexico.

Dakheel, A.J. 2002. Date Palm and Biosaline Agriculture in the United Arab Emirates. Paper presented at "The International Date Palm Forum: Date Palm Culture in the United Arab Emirates", September 2002. Abu Dhabi, UAE.

Dakheel, A.J. 2002. The role of biosaline agriculture in water and food security in the Gulf region. Paper presented at the UNESCO-ICBA Gulf Regional Workshop on Arid Ecosystems and Water Constraints, 27-28 October 2002. Dubai, UAE.

Dakheel, A.J. 2002. Strategies for developing salt-tolerant plant production systems for salt-affected environments in the UAE. Paper presented at Seminar on " Techniques for the Use of Saline Waters in Agriculture". Organized by Abu Dhabi Chamber of Commerce and Industry, 30 September 2002, Al-Ain, UAE.

Ismail, S. 2002. Growth, Productivity and Economic Feasibility of Halophytes for Sustainable Agricultural Production System. Paper presented at the "International Symposium on Optimum Resources Utilization in Salt-Affected Ecosystems in Arid and Semi-Arid Regions", Desert Research Center, Cairo, Egypt, 8-11 April 2002.

Ismail, S. 2002. Management and production of halophytes: Case studies of saline water use and reclamation of salt affected soils. Paper presented at the Second Saudi Symposium on Halophyte Plantation, Riyadh, Saudi Arabia, 17-20 March 2002.

Technical meetings attended

Al-Attar, M.H. 2nd Meeting of the IDB Advisory Panel on Science & Technology, IDB, Jeddah, Saudi Arabia, 1-2 January 2002.

Al-Attar, M.H. Symposium in the Scientific Research & Development Technology in the Arab World - Arab Science & Technology Foundation, Sharjah, UAE, 24-27 March 2002.

Al-Attar, M.H. AFESD Meeting, Abu Dhabi, UAE, 20 May 2002.

Al-Attar, M.H., F. Taha and S. Ismail. 2002. International Symposium on Salt-Affected and Saline Ecosystems and Side Meetings with Other Organizations, 8-13 April 2002, Cairo, Egypt.

Dakheel, A.J. First Meeting of Technical Advisory Group and Steering Committee of The Land Degradation Assessment in Drylands (LADA) Project. 23-25 January 2002, FAO Headquarters, Rome, Italy.

Dakheel, A.J. Date palm global network establishment meeting, Al-Ain, UAE University 7-9 April 2002. Organized by: United Arab Emirates University, Food and Agriculture Organization of the UN (FAO) and the United Nations Development Program (UNDP/UNOPS).

Dakheel, A.J. First Regional Arab Media Forum on the Environment and Sustainable Development (in preparation for the WSSD). 24-25 July 2002, Abu Dhabi, UAE.

Dakheel, A.J. International Conference on "Promoting Best Practices for Conservation and Sustainable Use of Biodiversity of Global Significance in Arid and semi-Arid Zones". Organized by: United Nations Environment Programme, Third World Network of Scientific Organizations and Global Environmental Facility (GEF). 14-17 December 2002, Cairo, Egypt.

ICBA reports

Dakheel, A.J. (compiler), M. Cutler and S.N. Vahidipoor. 2002. Partial list of salt-tolerant trees, shrubs and groundcover. Report to the Private Office of H.H. President of the UAE and Ruler of Abu Dhabi.

ICBA trip reports

Report/ICBA/23/02, 20-24/01/2002, Amman, Jordan, The International Atomic Energy Agency (IAEA) Annual Meeting for the Participants of the Project "Sustainable Utilization of Saline Ground Water and Wastelands for Plant Production", Prof. Dr. F.K. Taha

Report/ICBA/24/02, 23-25/01/2002, Rome, Italy, Participation in the First Meeting of the Technical Advisory Group and the Steering Committee of Land Degradation Assessment in Drylands (LADA) Project, Dr. A. Dakheel

Report/ICBA/24-A/02, 24/01/2002, Kuwait City, Kuwait, Brainstorming Meeting on Agricultural Research Priorities in the Arabian Peninsula, Dr. B. Hasbini

Report/ICBA/25/02, 16-18/02/2002, Islamabad, Pakistan, 10th General Meeting of Organization of Islamic Conference Standing Committee on Scientific and Technology Co-operation (OIC-COMSTEC), Dr. M.H. Al-Attar, Dr. S. Ismail

Report/ICBA/26/02, 30/03/2002, Kuwait. Visit to Arab Fund for Economic and Social Development Headquarters, & KISR Facilities, Dr. M.H. Al-Attar, J.J. Abraham

Report/ICBA/26-A/02, 8-13/04/2002, Cairo, Egypt. Participation at the "International Symposium on Salt-Affected and Saline Ecosystems and Side Meetings with Other Organizations", Dr. M.H. Al-Attar, Prof. Dr. F.K. Taha and Dr. S. Ismail

Report/ICBA/27/02, 28-30/04/2002, Abu Dhabi, U.A.E. 27th General Meeting of the AOAD, Dr. M.H. Al-Attar, Prof. Dr. F.K. Taha, I. Bin Taher

Report/ICBA/28/02, 08-10/05/2002, Aleppo, Syria, Participation in the "Agricultural Research Priority Setting in CWANA" and Side Meetings with Other Organizations, Prof. Dr. F.K. Taha

Report/ICBA/28-A/02, 17-18/06/2002, Accra, Ghana, Global Water Partnership 7th Annual Consulting Partners Meeting, Dr. B. Hasbini

Report/ICBA/29/02, 25/06/2002, Dubai, U.A.E., Meeting of Executive Directors 'Inter-Islamic Network' International Center for Biosaline Agriculture, Dr. M.H. Al-Attar, Dr. S. Ismail, H. Lashin

Report/ICBA/30/02, 04-08/08/02, Aleppo, Syria, Desertification, Poverty and Agriculture: Building Livelihoods, Saving Lands, Prof. Dr. F.K. Taha

Report/ICBA/31/02, 17-21/08/02, Jordan, Visit of ICBA Delegation to Jordan, Prof. Dr. F.K. Taha, Dr. J. Stenhouse, Dr. B. Hasbini

Report/ICBA/31 (1)/02, 13-17/09/2002, ICBA visit to Bangladesh, Dr. B. Hasbini and J.J. Abraham

Report/ICBA/31 A/02, 14-26/09/2002, Visit to Central Asia, Dr. M.H. Al-Attar and Prof. Dr. F.K. Taha

Report/ICBA/31 B/02, 13-15/10/2002, Cairo, Egypt, 3WWF/MNA Initiative, Prof. Dr. F.K. Taha

Report/ICBA/32/02: 18-24/10/02, 27th Annual Meeting of IDB Governors, Ouagadodu, Burkina Faso, Dr. M.H. Al-Attar, Prof. Dr. F.K. Taha, G. Jawad Al Jabri

Report/ICBA/33/02, 22-26/10/2002, World Food Prize Symposium, Des Moines, Iowa, World Food Prize Global Youth Institute, 26 October 2002, Dr. S.E. Child

Report/ICBA/34/02, 28/10/2002-1/11/2002, Manila, Philippines, CGIAR Annual General Meeting and meeting with Asian Development Bank, J.J. Abraham

Report/ICBA/35/02, 30/10/2002-1/11/2002, Bangkok, Thailand, Prof. Dr. F.K. Taha

Report/ICBA/36/02, 8-20/10/2002, ICARDA Headquarters, Aleppo, Syria, Wrap-up workshop for the needs assessment on soils and water, Prof. Dr. F.K. Taha

Report/ICBA/37/02, 2-4/12/2002, Penang, Malaysia, Seventh General Assembly of APAARI Expert Consultation on Strengthening of Research Partnerships, Prof. Dr. F.K. Taha

Appendix 4 Core staff as of 31 December 2002

Office of the Director General

Dr. Mohammad Al-Attar	Kuwait	Chairman of the Board of Directors/Director General
Mr. Ibrahim Bin Taher	UAE	Government Liaison Officer
Mr. Jugu Abraham	India	Donor Relations Specialist
Mrs. Hemmat Lashin	Egypt	Executive Secretary
Miss Amneh Al Azzeh	Jordan	Office Assistant
Mr. Akhtar Ali	India	Driver

Technical Programs

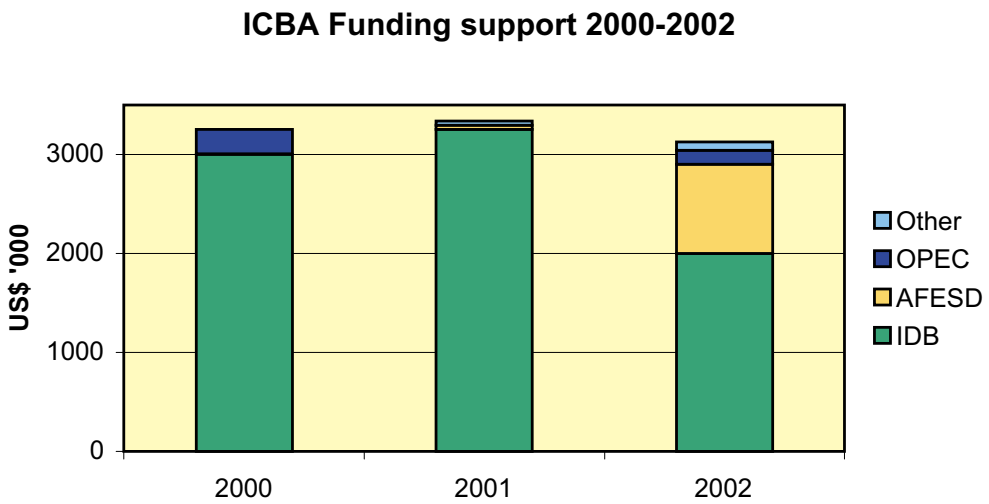
Prof. Dr. Faisal Taha	USA	Director, Technical Programs
Dr. Abdullah Dakheel	Syria	Field and Forage Crops Scientist
Dr. John Stenhouse	UK	Plant Genetic Resources Specialist
Dr. Shoaib Ismail	Pakistan	Halophyte Agronomist
Dr. Bassam Hasbini	Lebanon	Irrigation Management Scientist
Dr. Sandra Child	Australia	Communication Specialist
Mr. Peter Eichorn	Germany	Farm Management Consultant
Mrs. Mae Cutler	Canada	Library Consultant
Mr. Ghazi Abu Rumman	Jordan	Agronomy Laboratory Technician
Mr. Mohammad Shahid	Pakistan	Plant Genetic Laboratory Technician
Mr. Khalil Urrahman	Pakistan	Halophyte Laboratory Technician
Mr. Basil Al Aaraj	Jordan	Irrigation and Farm Technician
Mr. Wameedh Monther	Iraq	Farm Technician
Mrs. Jane Roberts	UK	Administrative Assistant
Mr. Ghazi Al Jabri	Syria	Administrative Assistant-Communications
Miss Sohila Vahidipoor	Iran	Library Assistant
Mr. Mohammad Shah	Pakistan	Tractor Driver/Farm Laborer
Mr. Hamzeh El Oudeh	Syria	Laborer
Mr. Saif Ul Islam Gul	Pakistan	Laborer
Mr. Omar Saeed	Sudan	Laborer

Administration and Finance

Mr. Ghassan Sarris	Canada	Administration and Finance Officer
Mr. Ghassan Al Eid	Lebanon	IT and Computer Supervisor
Mr. Jamal Telmesani	Saudi Arabia	Facilities Supervisor
Mrs. Souhad El Zahed	Lebanon	Office Administrator, End User Support
Mr. Sami Barakey	Palestine	General Accountant
Mr. Bilal Al Salem	Jordan	Administrator/Government Relations

Appendix 5 ICBA Funding 2002

		US$		
Donor Contributions		2000	2001	2002
	IDB	3,000,000	3,249,375	1,999,946
	AFESD		43,874	900,000
	OPEC Fund	250,000		140,000
	IAEA			18,612
	PDO		18,489	31,409
	Abu Dhabi Municipality			27,734
	BEHAR		22,500	
	IFAD			9,600
	Total	**3,250,000**	**3,334,238**	**3,127,301**



Appendix 6 Audited Financial Statements

Statement of Activities

Year ended 31 December 2002

	2002 USD	2001 USD
Revenues		
Grants - unrestricted	**2,824,193**	2,294,864
Contribution	-	273,318
Contribution against training courses and research	**122,641**	-
Contribution from outreach projects	**91,666**	-
Other income	-	103,655
Total revenues	**3,038,500**	**2,671,837**
Expenses		
Salaries	**(1,121,321)**	(999,662)
Benefits	**(698,934)**	(638,290)
Supplies	**(174,376)**	(122,153)
Board expenses	**(21,712)**	(9,353)
Contract services	**(160,936)**	(87,686)
Travel	**(143,520)**	(112,619)
Utilities	**(103,400)**	(68,398)
Maintenance	**(102,357)**	(78,219)
Depreciation	**(323,539)**	(282,139)
Irrigation water expenses	-	(273,318)
Expenses against training courses and research	**(122,641)**	
Expenses related to outreach projects	**(65,764)**	
Total expenses	**(3,038,500)**	**(2,671,837)**
Excess of revenues over expenses	-	-

Statement of Financial Position

At 31December 2002

	2002 USD	2001 USD
ASSETS		
Current assets		
Bank balances and cash	**1,463,135**	2,254,915
Accounts receivable	-	8,934
Prepayments and other assets	**5,973**	56,161
	1,469,108	2,320,010
Non-current assets		
Property, plant and equipment net	**6,329,690**	6,338,836
	6,329,690	6,338,836
TOTAL ASSETS	**7,798,798**	**8,658,846**
	2002 USD	**2001 USD**
LIABILITIES AND NET ASSETS		
Current liabilities		
Accrued expenses and other liabilities	**145,700**	1,007,732
	145,700	1,007,732
Non-current liabilities		
Provision for end-of-service benefits	**29,743**	22,286
	29,743	22,286
Net assets		
Unrestricted - Unappropriated	**6,653,226**	6,338,836
Unrestricted - Appropriated	**541,976**	882,904
Temporarily restricted	**428,150**	407,088
Total net assets	**7,623,355**	**7,628,828**
TOTAL LIABILITIES AND NET ASSETS	**7,798,798**	**8,658,846**

Appendix 7 Acronyms and Abbreviations

AFESD	Arab Fund for Economic and Social Development
AFDW	ash-free dry weight
AFLP	amplified fragment length polymorphism
BARI	Bangladesh Agricultural Research Institute
BEHAR	Arabian Saline Water Technology Company
CGIAR	Consultative Group on International Agricultural Research
COMSTECH	Organization of the Islamic Conference Standing Committee on Scientific and Technological Cooperation
DFID	Department for International Development, UK
DRC	Desert Research Council
EC	Electrical Conductivity
ERWDA	Environmental Research and Wildlife Development Agency
FAO	Food and Agriculture Organization
GBN	Global Biosaline Network
GCC	Gulf Cooperation Council
IAEA	International Atomic Energy Agency
ICARDA	International Center for Agricultural Research in the Dry Areas
ICARDA-APRP	International Center for Agricultural Research in the Dry Areas - Arabian Peninsula Research Program
ICBA	International Center for Biosaline Agriculture
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDB	Islamic Development Bank
IFAD	International Fund for Agricultural Development
INBA	Inter-Islamic Network on Biosaline Agriculture
LADA	Land Degradation Assessment in Drylands
MAF	Ministry of Agriculture and Fisheries, UAE
MoU	Memorandum of Understanding
OPEC	Organization of Petroleum Exporting Countries
PDO	Petroleum Development Oman
SPC	Sewerage Projects Committee, Abu Dhabi
UAE	United Arab Emirates
UAEU	United Arab Emirates University
USDA	US Department of Agriculture
WANA	West Asia and North Africa

ICBA's founding donors

Islamic Development Bank

The Islamic Development Bank (IDB), established in 1975, is an international financial institution. IDB operates from its headquarters in Jeddah, Saudi Arabia and from regional offices in Malaysia, Morocco and Kazakhstan. It now has 54 member countries.

IDB is an international development finance institution whose purpose is to foster the economic development and social progress of member countries and Muslim communities, individually and jointly, in accordance with the principles of Islamic law (*shari'ah*).

In pursuit of its objectives, the Bank focuses on three strategic objectives: poverty alleviation, cooperation among member countries, and the promotion of Islamic banking and finance. The Bank's assistance targets six priority areas: human development, agricultural development, trade among member countries, private-sector development, and Islamic banking and finance.

The Bank is charged with the responsibility of assisting in the promotion of foreign trade, especially in capital goods, among member countries; providing technical assistance to member countries; and extending training facilities for personnel engaged in development activities in Muslim countries to conform to the Shari'ah.

Arab Fund

The Arab Fund for Economic and Social Development (AFESD) is an autonomous regional Pan-Arab development finance organization. Its membership consists of all states who are members of the League of Arab States.

The function of AFESD is to assist the economic and social development of Arab countries through, firstly, financing development projects, with preference given to overall Arab development and to joint Arab projects; secondly, encouraging the investment of private and public funds in Arab projects; and, thirdly, providing technical assistance services for Arab economic and social development.

OPEC Fund

The OPEC Fund for International Development is a multilateral development finance institution. It was established in January 1976, by the member countries of the Organization of the Petroleum Exporting Countries (OPEC) following a decision taken in March 1975 by the Sovereigns and Heads of State of OPEC, meeting in Algiers.

The OPEC Fund aims to promote cooperation between OPEC member countries and other developing countries as an expression of South-South solidarity and to help particularly the poorer, low-income countries in pursuit of their social and economic advancement.

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