

Biosalinity News

Newsletter of the Biosaline Agriculture Center

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FROM THE EDITOR

Biosalinity News is produced three times a year by the Biosaline Agriculture Center.

Our vision is for this newsletter to serve as a forum for exchange of news and information among people interested in research and development activities in saline agriculture. But to achieve this, we need your help and your input.

This issue carries articles highlighting work not only at BAC but also at the United Arab Emirates University at Al Ain, UAE, as well as a report on a recent seminar held in Pakistan on "Prospects for Saline Agriculture". Future issues will carry articles on other organizations working in the field of saline agriculture.

The Editor would be glad to receive submissions on subjects relating to saline agriculture, especially short articles on research and development experiences, announcements of seminars, workshops, meetings and training courses, and reviews of new publications. Please send submissions to:

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BAC'S STRATEGIC PLAN TAKES SHAPE

Partnership, sustainability, applicability, transfer of knowledge and technologies—these are recurrent themes that run through and underpin BAC's Strategic Plan for 2000–2004.

BAC was established in the face of a growing global realization that freshwater resources in much of the developing world are overexploited yet much of the world's future food production will depend on irrigation. Over half of the world's groundwater resources are already saline, and the proportion is increasing. Crop production is limited by salinity on about half of the world's irrigated land. Water is seen as the first limiting resource in more and more agricultural systems. Countries of the Islamic World are among the most disadvantaged in the world in terms of availability of fresh water.

Against this background, the Islamic Development Bank (IDB) initiated a series of meetings on water-related issues in the late 1980s and early 1990s. These led to a consensus that a new research and development center was needed to promote the use of saline water in productive sustainable agriculture in the Islamic World. Following extensive reviews of the nature and extent of the problems facing irrigated agriculture in the IDB member countries and of the technology and know-how available, BAC was established in the United Arab Emirates.

These early reviews underpin many of the Center's initial strategic choices, particularly its choice of regional focus (initially the countries of the Gulf Cooperation Council (GCC)), crops and agro-ecological zones, and its emphasis on partnerships, information sharing, networking, and technology transfer.

BAC's strategic choices

Any organization is faced with making strategic choices, which are driven in part by the nature and scope of its "market" (the problem of salinity in irrigated agriculture, in the case of BAC), its "client base", its core strengths, its "competitors" or "alternative suppliers", and many other factors. This is the process that BAC has undertaken in developing its strategic plan for the next five years. The following paragraphs outline some of the considerations that have shaped this plan.

Windbreaks on BAC's Al Ruwayyah station.



A.A. Jaradat

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Focuses

Plant genetic resources are the basis of agriculture, today and tomorrow. Without them, there is no scope for developing novel approaches to producing more food to feed the world's growing human population. But conserving plant genetic resources is not enough on its own. Once promising plants have been identified, they must be fitted into practical and applicable production systems if they are to contribute to food production. These are the two focuses for BAC's program: acquiring, conserving, and evaluating salt-tolerant plants from around the world, and developing production systems based on these genetic resources that farmers and landscape managers can use.

Geographical coverage

BAC is focusing its initial efforts on the GCC countries of the Arabian Peninsula. This choice is dictated by the urgent need to address water use and quality issues in this region, whose renewable water resources per person are less than 3% of the global average.

The Middle East region (defined here as the North African countries from Mauritania, through the countries of the Fertile Crescent, the



Arabian Peninsula, Turkey, Iran, Pakistan, Afghanistan, and the former Soviet republics in Central Asia) covers 14% of the total area of the world and is home to 10% of its population, yet has only 2% of the world's renewable water resources. Renewable water resources per inhabitant are among the lowest in the world at an average of 1577 m³/person per year, compared with the global average of 7000 m³. Sixteen of the 29 countries in the region have internal renewable water resources of less than 500 m³/person per year. The figure for the countries

of the Gulf Cooperation Council is just 197 m³.

Some 91% of water withdrawn in the region is used for agriculture, compared with the world average of 69%.

Countries of the Arabian Peninsula are using up their

water resources over three times as fast as they are being renewed. Already, water tables have dropped dramatically across the Peninsula and readily available water resources will be exhausted within the next 20 years unless consumption of fresh water is reduced. The only way this will be achieved is by improving water-use efficiency in current agricultural systems and developing novel systems that use alternative sources of water. This is where BAC has a clear role to play, in developing productive agricultural and environmental greening systems that use non-conventional water resources, such as saline and brackish water.

Agro-ecozones

BAC's mandate calls on the Center to work for "socio-economic development in the arid and semi-arid areas ... of the Islamic world and elsewhere." The choice of the GCC countries as the Center's initial focus dictates an initial focus on arid environments in the subtropics. As the program develops, emphasis will expand to cover semi-arid and Mediterranean environments.

Land and water

Most of the world's arable land is already being cropped—there is little scope for increasing the amount of "traditional" farmland under cropping. Where there is scope is for developing production systems that make use of unused or underused land—marginal land and coastal land that is now thought of as too salty for productive use.

Saline and brackish water resources are far more abundant than fresh water and little used at present. Bringing these resources into sustainable productive use will offer opportunities to increase food

Salt-encrusted plots at Al Ruwayyah, Dubai.



Paul Naciri

security in many of the most needy regions of the world.

Crops

Over half the irrigated area in the GCC countries is planted to forages, 26% to cereals, and 20% to horticultural crops (FAO statistics). BAC believes that the greatest opportunity for use of saline irrigation water, at least in the short term, lies in developing forage production systems based on non-traditional forage plants. Given the area planted to forages, success in this endeavor would also have the greatest impact on conserving freshwater resources. BAC will initially focus 80% of its efforts on irrigated agriculture.

The GCC countries also expend large amounts of water in landscaping and environmental greening programs in their cities and along highways. Currently much of the urban greening relies on reclaimed urban water, while the plantings along highways use groundwater. Given the large population centers along the coast of the Arabian Peninsula, there are considerable opportunities to use saline water to irrigate ornamental and landscaping plants. Better water management and use of saline groundwater also would benefit greening and sand stabilization along highways. Twenty per cent of BAC's initial programs will focus on greening projects.

Target audiences

The end-users of the technical products of BAC's programs are farmers growing forage and keeping livestock and managers of landscaping and environmental greening programs. However, the information and knowledge generated by the Center's activities will be of great benefit to, and targeted at, govern-

BAC's strategic choices	
Core business	<ul style="list-style-type: none"> • Developing sustainable management systems to irrigate forage and food crops and greening plants with saline water • Providing a resource of salt-tolerant plants • Providing training and information on saline irrigated agriculture and associated technology
Focuses	<ul style="list-style-type: none"> • Conservation and use of plant genetic resources • Development of production and management systems
Geographical coverage (phased)	<ul style="list-style-type: none"> • Gulf Cooperation Council countries • Other regions of the Islamic World • Global
Agro-ecozones	<ul style="list-style-type: none"> • Arid • Semi-arid • Mediterranean • Sub-tropical
Land and water categories	<ul style="list-style-type: none"> • Marginal and coastal land • Saline water resources
Crops	<ul style="list-style-type: none"> • Forage • Plants for environmental greening and ornamentals • Date palm
Target audiences	<ul style="list-style-type: none"> • Plantation managers • Forage producers • Livestock producers • Municipalities • Government policy- and decision-makers • Entrepreneurs • Scientists
Partners	<ul style="list-style-type: none"> • National and public institutions • Ministries of agriculture and water resources • Universities • Regional and international research centers • Development agencies • Private sector companies

ment policy- and decision-makers. These people determine the policy environment in which producers operate and their informed support can generate far more impact than BAC alone could hope to have.

Entrepreneurs and the private sector will be important audiences for

the Center's outputs. Increasingly, development agencies are recognizing the role of the private sector in delivering improved technologies and products to a wide audience and BAC intends to involve private sector partners in both technology generation and product delivery.

Partnerships

BAC is not the only center working in the field of saline irrigated agriculture. Research programs around the world have studied salt-tolerance in plants, particularly in low-rainfall areas, and some have focused on irrigation with saline water, up to and including seawater. However, little of this work has focused on the problems of farmers in the develop-

ing world or on developing solutions suited to low-external-input agriculture.

BAC's role is primarily to bring to bear or adapt what is already known to solve problems facing farmers and greening programs in its mandate areas. This will depend on the Center's 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.

A central feature of these partnerships will be the involvement of all parties in problem identification, project planning, implementation and reporting.

BAC'S TECHNICAL PROGRAM

BAC's basic philosophy is that, together with its partners, it should approach biosalinity problems in an integrated and holistic manner. Indeed, it is one of BAC's core strengths that it has an integrated base of scientific expertise covering plant genetic resources, irrigation and soil salinity management, and specialized agronomy. Working together, these specialists form a strong core on which to build multidisciplinary research teams with our partners.

The Center's portfolio of research and technology delivery is divided into three programs:

- Genetic resources: The conservation of germplasm of salt-tolerant plants through the introduction, characterization, storage and distribution of potentially salt-tolerant plants for production under saline conditions
- Production and management systems: The evaluation of field, horticultural and halophytic crops for varying levels of salinity in irrigation water and the development of irrigation management and production systems

- Information management, networking and training: Gathering, storing, synthesizing, and disseminating information on biosaline agriculture through a global network of scientific organizations and conduct of professional training of scientists, technology transfer and extension programs

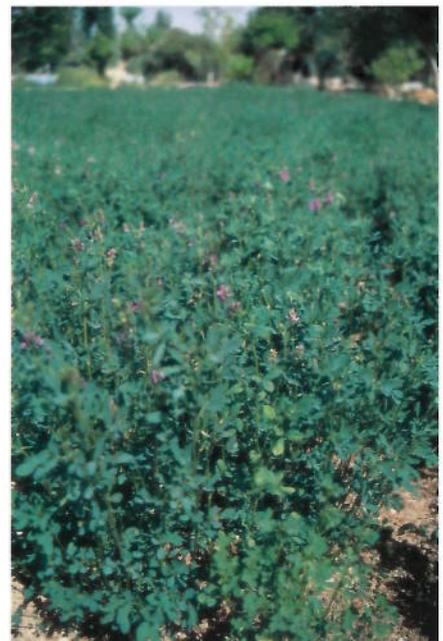
The Center has identified 11 priority research projects for the period 2000–2004 (see below).

Priority research projects, 2000–2004

- Plant genetic resources acquisition and conservation
- Screening of forage crops for salt tolerance
- Screening and evaluation of halophytes
- Performance and management of irrigation systems for sustainable crop production
- Management of soil salinity and fertility
- Management practices for salt-tolerant annual and perennial

- forage and fodder crops
- Management practices for forage halophytes
- Propagation and management practices for landscape and ornamental halophytes
- Evaluation and documentation of date palm genetic resources for salinity tolerance
- Networking and information management
- Human resource development and technology transfer

Alfalfa growing at Al Ruwayyah, Dubai



Paul Naegele

BAC'S FIRST CROP HARVESTED

BAC has recently harvested the first crop to be grown on its station at Al Ruwayyah, near Dubai, UAE.

The crop, a block of some one-and-a-half hectares of Omani landrace barley, was planted in December 1999 to help stabilize the sandy soil on the site and to make the soil more uniform before it is planted with experiments later in 2000.

The land at the station was leveled in 1998 and 1999 to provide an area on which irrigated experimental and demonstration trials could be laid out. But this involved extensive disturbance of the soil, which consists almost entirely of sand. "We wanted to plant a relatively uniform crop to determine the extent of variation in the soil and to bring it to reasonable degree of uniformity before we start our trial program in November 2000," said Dr. Abdulla Jaradat, Plant Genetic Resources Specialist at BAC. "This is the first time this land has ever been cropped."

Dr. Jaradat chose the Omani barley landrace because it is adapted to the local climatic and environmental conditions and because barley is an important feed crop in the region. He acquired the seed from Al Batinah in Oman. Barley is commonly grown with irrigation from underground water supplies. "Salinity is said to be a problem in the Al Batinah area, which suggests that the local landrace will have been selected for salinity tolerance," said Dr. Jaradat.

The barley was planted at a seed rate of 100 kilograms per hectare and given a basal dressing of ammonium sulfate fertilizer. It was subse-

quently top-dressed with potassium sulfate and urea. Travelling irrigators were used to apply about 10 mm of moderately saline water (approximately 3300 parts per million) every other day.



"Almost as soon as the crop started to come through it was apparent that there is enormous genetic variation in the Omani landrace," said Dr. Jaradat. "So we took the opportunity to select within the population to capture the variability and provide material for a selection program designed to meet the needs of farmers in this region." Some 3000 spikes—or seed heads—have been collected, covering the wide differences in the morphology of the plants, including spike size, shape, and color, two-row and six-row types, height, rate of growth, tillering ability and the like. Seed from each of these spikes will be planted out in single rows in November 2000 and the plants screened for their tillering ability, vegetative growth, seed yield, and tolerance to salinity.

"Rate of growth is an important characteristic in this environment," states Dr. Jaradat. "The growing season is short, yet we are looking to get at least two harvests of green leafy growth before allowing the

barley to set seed and mature."

The crop has already stimulated local interest. The manager of a local commercial dairy farm saw the crop as he drove past and came to the Center to ask for more information. Providing enough good quality feed for his cows is a major problem, one that he is currently addressing by growing barley using hydroponics. Having discussed BAC's first crop with Dr. Jaradat, the manager is now evaluating the Omani landrace barley in his hydroponics system and is testing its feed value, particularly its protein content. BAC plans to work with the dairy farm to develop a practical forage production system based on growing barley under irrigation with brackish water.

From a simple start aimed at stabilizing the soil and making the land ready for next season's trials, BAC's barley work seems set to have an impact on local feed production sooner than expected.

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BAC SIGNS FIRST AGREEMENTS

Aleppo, Syria—The Biosaline Agriculture Center signed its first Memorandum of Understanding with another organization on 5 April 2000. The MoU was signed with the International Center for Agricultural Research in the Dry Areas (ICARDA), an Aleppo-based international agricultural research and training institute. ICARDA's mission is to improve the welfare of people in the dry areas of the developing world by increasing the production and nutritional quality of food and feed for livestock while preserving, enhancing and conserving the natural resource base of the dry lands. ICARDA is one of 16 centers world-wide supported by the Consultative Group on International Agricultural Research (CGIAR), an informal association of 58 public and private sector members funding efforts to contribute to food security and poverty eradication in developing countries through research, partnership, capacity building, and policy support.

The agreement, signed by Dr. Mohammad H. Al-Attar, Director General of BAC, and Prof. Dr. Adel El-Beltagy, Director General of ICARDA, provides for collaboration between the two organizations in research, technology transfer, and training, and exchange of scientific information and staff. Signing the agreement for BAC, Dr. Al-Attar noted, "ICARDA is a logical first partner for BAC, with its history of achievement and great experience in the region, and with its Arabian Peninsula Research Program based in Dubai. It is the only major international agricultural research center to



Dr. Mohammad Al-Attar (right), Director General of BAC, and Prof. Dr. Adel El-Beltagi (left), Director General of ICARDA, signing the new agreement between the two centers.



Dr. Mohammad Al-Attar (seated second from right), Director General of BAC, and Dr. Kauser Abdulla Malik, Chairman of PARC (seated second from left), signing the BAC-PARC agreement.

focus on the problems of agriculture in the arid zones, our common focus. By joining forces with ICARDA, and drawing on your experience, I hope that our new center will be able to progress rapidly in fulfilling its mission."

During the visit to ICARDA's headquarters, Dr. Al-Attar and Dr. Abdullah Jaradat, Plant Genetic Resources Specialist at BAC, also held talks with ICARDA scientists about collaboration on agro-ecological characterization of farming systems in the oases of the Arabian Peninsula and on evaluation of elite vetch and lathyrus germplasm for salinity tolerance.

Islamabad, Pakistan—BAC signed a Memorandum of Understanding with the Pakistan Agricultural Research Council (PARC) on 10 April 2000 at an international seminar on "Prospects for Saline Agriculture" in Islamabad, Pakistan. The Memorandum was signed by Dr. Al-Attar, BAC Director General, and Dr. Kauser Abdulla Malik, Chairman of PARC. As with the ICARDA agreement, this MoU provides for collaboration between the two organizations in research, technology transfer, and training, and exchange of scientific information and staff.

The Islamabad seminar was organized jointly by the Pakistan Academy of Sciences, the Pakistan Agricultural Research Council, and the Standing Committee for Scientific and Technical Cooperation of the Organization of Islamic Countries.

Dr. Ahmed Al Masoum, UAE University

SEMINAR FOCUSES ON PROSPECTS FOR SALINE AGRICULTURE

Salinity and waterlogging have reduced by 40% the amount of land under irrigation in Pakistan in recent years, according to Mr. Muhammad Rafiq Tarar, President of Pakistan. Mr. Tarar made this observation in his opening address to the international seminar on "Prospects for Saline Agriculture", held in Islamabad, Pakistan, 10–12 April 2000. The President expressed his hopes that the seminar would help identify viable, cost-effective methods for selecting, testing, and growing salt-tolerant plants on a commercial scale under saline conditions.

Twenty countries represented

The seminar, organized by the Pakistan Academy of Sciences, the Pakistan Agricultural Research Council, and the Standing Committee for Scientific and Technical Cooperation of the Organization of Islamic Countries, brought together scientists from Australia, Bangladesh, Canada, China, Egypt, Germany, Iran, Japan, Mexico, The Netherlands, Pakistan, Peru, Russia, Saudi Arabia, Syria, Tunisia, UAE, UK, USA, and Uzbekistan to review the current state of knowledge in saline agriculture and to identify areas for future research and development activities.

"Development of saline agriculture will not only arrest the process of [salinization] due to poor irrigation practices...but shall also help diversify agriculture by utilizing thousands of hectares of saline lands," stated Syed Shafqal Ali Shah Jamot, Federal Minister for Food, Agriculture and Livestock, Pakistan, in a newspaper article on the day of

the seminar's opening. "The [symposium] affords an excellent opportunity to learn from each other's experience," noted Dr Kauser Abdulla Malik, Chairman, Pakistan Agricultural Research Council, in the same issue of *The Nation* newspaper. "Salinity is the most significant and prevalent abiotic stress facing agriculture in both developed and developing countries."

The challenge is to develop economically productive, culturally appropriate and environmentally sound agricultural systems for saline lands

"The challenge confronting scientists is to match plant species and agronomic practices to the land and water environment to develop economically productive, culturally appropriate and environmentally sound agricultural systems for saline lands," said Professor Riaz Hussain Qureshi, Vice Chancellor, University of Agriculture, Faisalabad, Pakistan.

Dr. Ed Barrett-Lennard, from the Centre for the Management of Arid Environments, Australia, said in an interview with *The Nation*, "I suspect that 100 years from now, the use of salt-tolerant plants in saline agricultural systems will be so common [in Pakistan] that we will have forgotten that there was any other way of doing things." He went on to note that, "Modern research has identified more than 1500 plant species that have high levels of tolerance to saline soils...These plants are a major resource that can be used in the development of agricultural systems for salt-affected soils."

Call for action

In a special session convened at the Pakistan Academy of Sciences, participants called for:

- Stronger linkages with the United Nations Conventions on Biological Diversity and on Combating Desertification
- A survey of data holdings on halophytes, salt-tolerant plants and salt-affected soils in the region
- Collection of indigenous forage plants from salt-affected areas
- More emphasis on halophytes in areas where water availability is very low
- More participatory research
- Creation of new market niches for products from salt-tolerant plants
- Promotion of awareness of and public support for saline agriculture through training, workshops, seminars and the Internet
- Creation of botanical gardens or field genebanks for halophytes and salt-tolerant plants
- *In situ* conservation of important halophytes
- Development of seed banks and seed production of halophytes and salt-tolerant plants, with involvement of the private sector
- Establishment of regional networks on saline agriculture
- Development of national strategies for conservation of drylands and biodiversity of salt-tolerant plants.

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SALT-TOLERANT GRASS SHOWS PROMISE AS LIVESTOCK FEED IN UAE

People like to eat meat and dairy products. As incomes rise, people tend to eat more meat and consume more dairy products. Meeting the increasing demand for livestock products without harming the environment is one of the many challenges facing agricultural development workers around the world.

Research at the United Arab Emirates University at Al Ain, UAE, shows that a salt-tolerant grass could help boost livestock production in the UAE using abundant saline water resources. Currently, most of the country's forage comes from irrigated forage farms growing Rhodes grass. Rhodes grass requires good-quality water to produce reasonable yields, but good-quality water is in short supply in the region and is the subject of increasing competition between agricultural, industrial, and domestic use.

A joint research program between the Faculty of Agricultural Sciences, UAE University, and the Zayed International Agricultural and Environmental Research Program has been investigating halophytes that show good forage potential for use in large-scale irrigated production systems. This program has identified sporobolus grass (*Sporobolus virginicus*) as being of potential use.

Agronomic studies at the Nahshalla farm of the Zayed International Agricultural and Environmental Research Program showed that the grass can be grown with irrigation water containing up

to 20,000 ppm total dissolved salts—far beyond that tolerated by Rhodes grass or other traditional forage crops grown in the region. Under these conditions, sporobolus gave dry matter yields of 17.5 tonnes per hectare per year from three cuts with minimal fertilizer application. This compares with annual yields of 30–40 tonnes per hectare from Rhodes grass cut seven to nine times a year, but these yields are achievable only with application of ample low-salinity irrigation water, high levels of fertilizer, and intensive management.

One of the great benefits of sporobolus as a forage is its relatively low ash content (see table).

Chemical composition of sporobolus and Rhodes grass hays (DM basis).

Item	Rhodes grass ¹ hay	Sporobolus grass ² hay
Crude protein	11.1	6.3
Ether extract	1.6	1.7
Acid detergent fiber	38.4	38.9
Neutral detergent fiber	72.8	75.9
Ash	10.0	12.5

¹ Irrigated with low-salinity water (2500 ppm).

² Irrigated with high-salinity water (20,000 ppm).

Most halophytes have high ash contents, reflecting the salts that accumulate in their tissues, yet the ash content of sporobolus was similar to that of Rhodes grass grown on non-saline soil with low-salinity irrigation water (2500 ppm total dissolved salts). High ash contents tend to reduce the palatability of forage and increase the amount of water animals must drink. Sporobolus does not suffer from this problem.

In feeding trials, camels ate less sporobolus hay than Rhodes grass hay when offered the hays as the only source of forage in a diet supplemented with camel concentrate and date-palm fruits. Camels fed Rhodes grass were slightly heavier and slightly fatter at the end of the 20-day feeding periods, but the difference was not significant.

These results suggest that sporobolus has a real potential for use in rehabilitating salt-affected desert areas throughout the Gulf region. Such salt-tolerant plants with high forage potential could dramatically increase the productivity of underutilized saline environments and increase forage production for domestic animals and wildlife. This may reduce grazing pressure on natural desert vegetation and conserve freshwater resources that are currently used in intensive forage production systems.

Researchers at UAE University are currently developing sporobolus-based forage production systems that would maximize productivity while helping maintain or improve salt-affected desert areas.

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