



# Biosalinity News

## Newsletter of the International Center for Biosaline Agriculture

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### FROM THE EDITOR

The lead article in this issue concerns the launching of the Arab Water Academy. This important institution, which ICBA has vigorously pursued over the past year with two of our most important partners, the Arab Water Council and Environment Agency-Abu Dhabi, is now a reality.

We also announce that ICBA has been selected to host the next International Salinity Forum. Reports on our newest MoU and a recent meeting of our Board of Directors are also included in this issue.

Two science articles appear as well. Our Genetic Resources staff report on the surprising salt tolerance of asparagus, and a paper submitted by two Australian research partners gives us an update of NyPa Forage, one of the most salt-tolerant plants ever developed.

*Contributions on research or projects of interest to our readers are always welcome, as are letters to the Editor. Please send your submissions, including relevant photographs and figures, to:*

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## Arab Water Academy launches this month

The Arab Water Academy (AWA), an institution established by the Arab Water Council (AWC) and co-hosted by both Environment Agency-Abu Dhabi (EAD) and ICBA, will be formally launched at a ceremony at the Emirates Palace Hotel in Abu Dhabi on 6 July. The ceremony will feature a Patronage Speech by His Highness Sheikh Hamdan bin Zayad Al Nahyan, Deputy Prime Minister of the UAE and Chief Executive Officer of EAD. The speech will be delivered by HE Dr Rashid Bin Fahed, Minister of Environment and Water.

The opening speech of HH Sheikh Hamdan will be followed by presentations by HE Dr Mahmoud Abu-Zeid, Minister of Water Resources and Irrigation, Egypt, and President of the Arab Water Council; HE Dr Ahmed Mohamed Ali, President of the Islamic Development Bank; HE Fawzi AlSultan, Chairman, ICBA; and Dr Joseph Saba, Director of the Strategic Operations



*The AWA triumvirate: HE Majid Al Mansouri, Secretary General, EAD; HE Dr Mahmoud Abu Zaid, President, AWC; HE Mr Fawzi AlSultan, Chair, Board of Directors, ICBA .*

Department, MENA Region, World Bank. Prof Dr Walid Abderrahman, Arab Water Council, will also speak.

The importance of the AWA for the Arab region cannot be overemphasized. A specialized institute that articulates, designs and implements new training initiatives to enhance capacity building in the water sector, the Academy is a significant investment in the human capital of decision makers, professionals and scientists.

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## ICBA to host next International Salinity Forum



Dr Richard Price, Convener of the 2nd International Salinity Forum held in Adelaide, South Australia (reported in our last issue), has written to confirm

that ICBA will host the next meeting of this prestigious scientific forum on salinity. Prof Dr Faisal Taha, who represented ICBA in Adelaide, will succeed Dr Price as Convener. Congratulations to ICBA and to Dr Taha.

### RESOLUTION OF THE INTERNATIONAL STEERING COMMITTEE ON COMPLETION OF THE 2ND INTERNATIONAL SALINITY FORUM THURSDAY 3 APRIL 2008

*At the completion of the 2nd International Salinity Forum the International Steering Committee resolved the following:*

- i) that a 3rd International Salinity Forum should be convened in 2011 (approximately in March);*
- ii) that the International Center for Biosaline Agriculture (ICBA) be requested to be the Hosting institution and that Dubai in the United Arab Emirates be the preferred location of a 3rd Forum; and*
- iii) that the role of Convener for the Forum should be passed from Dr Richard Price to Professor Faisal Taha for the duration of the period leading to the 3rd Forum and for the Forum itself.*

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## Asparagus: a high-value vegetable crop with potential

NK Rao and Mohammed Shahid, Plant Genetic Resources Program, ICBA

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The UAE climate is characterized by low rainfall, high temperatures and salinization. Despite these constraints, the agriculture sector has made considerable progress over the last two decades. Largely because of government incentives, the area under cultivation increased from 15,000 ha in the 1970s to a current figure of about 260,000 ha.

Although vegetables occupy only a fourth of the total cultivated area, they comprise a significant share of agricultural output, both in quantity and value. In 2001, the UAE produced 720,000 tons of vegetables, meeting nearly half of local demand. The most common vegetables grown in the UAE are tomato, squash and cabbage.

ICBA's Genetic Resources Program has been studying various crops for local adaptation and for successful cultivation with saline and marginal irrigation water. The aim is twofold: to provide farmers with a wide range of options and to contribute to the UAE's goal of achieving self-sufficiency in vegetable production. One of these crops, asparagus (*Asparagus officinalis* L.), has significant potential.

A member of the lily family, asparagus originated in the eastern Mediterranean region. The crop is one of the most salt-tolerant plants cultivated by humans. Asparagus is grown in many subtropical and temperate parts of the world and is commercially important in France, Mexico, Peru, Spain and the USA. In terms of nutritional value, asparagus ranks among the top 10 vegetables. It is an excellent source of vitamins A, C and K, as well as folacin, riboflavin, niacin, thiamin and minerals like copper, phosphorus, potassium and iron. It is also rich in dietary fiber. For complete nutritional information, visit the George Mateljan Foundation website at [www.whfoods.com](http://www.whfoods.com).



**If not harvested, asparagus spears develop into fernlike appendages.**

Asparagus is a tall upright bush with rhizomes and fleshy fibrous roots. The plant is dioecious; that is, it bears either female or male flowers, not both. If the flower is female, it produces a small round, reddish berry with six seeds.

Pollen is carried from male plants to female plants by insects.

Recently, ICBA acquired 10 germplasm accessions from Cornell University. After the seeds were germinated in jiffy packs in December 2006, 12-week-old seedlings were transplanted into a field. During the first year of growth, a single dose of urea one month after planting and two split doses of NPK (20-20-20) were applied by banding alongside the plants. All the accessions grew extremely well with no incidence of pests. The plants produced large numbers of spears in the spring, which were allowed to grow into ferns and flowering shoots for seed production.

Although asparagus normally requires three full growing seasons before spears can be harvested, the crop's performance in this trial showed excellent adaptation and high potential for cultivation.

Asparagus is highly favored by today's health-conscious consumer. Unlike most vegetables, asparagus is a perennial crop. Once established, it is inexpensive to maintain and given proper care remains productive for 12-15 years. ICBA will be pleased to make available small quantities of seeds or crowns for horticulturists in the UAE interested in this high-value crop.



**Asparagus spears: salt-tolerant and nutritious.**



**Asparagus berries.**



**Asparagus spear ready for harvesting.**

## ICBA attends AGM of the Islamic Development Bank



*Dignitaries at the ICBA seminar. From left: Dr Abdulrahman K Al-Khalaf, Dean, Faculty of Meteorology Environment and Arid Land Agriculture, King Abdulaziz University (KAU); Mr Fawzi AlSultan, Chairman, ICBA Board of Directors; Dr Amadou Cisse, Vice President of Operations, Islamic Development Bank; Prof Abdullah O Bafail, Vice-President for Postgraduate Studies and Scientific Research, KAU.*

The Annual General Meeting of the Islamic Development Bank (IDB) was held at the Bank's headquarters in Jeddah, Saudi Arabia, this year. ICBA was invited to present a seminar about its work at the meeting. The seminar, which was held at the Westin Jeddah Hotel, was well received.



In his welcome address, Dr Cisse recognized the contributions of ICBA to research on biosaline agriculture and marginal water issues, and congratulated KAU on its decision to enter into collaborative research with ICBA. On behalf of ICBA, Board Chair Mr AlSultan thanked Dr Cisse, and expressed enthusiasm about the new joint venture.

*Left: ICBA's seminar stimulated a lively discussion session.*

### New MoU

One important development that took place during the AGM was the signing of an important Memorandum of Understanding between KAU and ICBA. The two institutions pledged to undertake collaborative research on the problems of marginal water and related issues over the next 5 years.

*HE Prof Usamah Bin Sadeq Tayyeb, President of KAU, seals the MoU by shaking hands with ICBA Board Chair Mr Fawzi AlSultan as ICBA Director General Dr Shawki Barghouti looks on.*



## ICBA Board meeting

The ICBA Board of Directors met for the first time in 2008 on 10 June to approve the Work Plan and Budget for 2008 and make recommendations concerning the road ahead for ICBA's research and development strategy.

*Above right, seated: Mr Majid Al Mansouri, Mr Fawzi AlSultan (Chair), Dr Mona Bishay, Dr Mohammad Al-Attar, Dr Mahmoud Solh. Standing: Dr Shawki Barghouti, Eng Abdulla Mohammed Rafia, Mr Mohamed Ennifar, Dr Mohammed Al Mulla.*

*Below right: Dr Abdullah Dakheel, Field and Forage Group Scientist, with Dr Mahmoud Solh, Director General of ICARDA,*

*Far right: Dr Bishay, Director, Near East and North Africa Division, IFAD, shares a thought with Board Chair Fawzi AlSultan.*



## Field trip with a difference

In February, ICBA was invited to visit one of the UAE's most unusual places, Sir Bani Yas Island. The island was a pet project of Sheikh Zayed, the father of the nation. His idea was to transform the barren island into a game reserve for both indigenous and exotic species. Unfortunately, he passed away before his dream could be fully realized, but his successors have continued to develop the island, which currently provides



*ICBA's expertise with forage materials is needed to avoid expensive imported hay like the alfalfa pictured above. Below: the Arabian oryx, an indigenous species, thrives on the island.*



*Sheikh Zayed's vision has transformed the previously barren island into a wildlife refuge.*

sanctuary to about 24,000 wild animals, including oryx, gazelle, giraffe, ostrich, emu, llama and many other animal species, as well as an array of salt- and heat-tolerant plant species, all of which are nourished by desalinated seawater.

At the invitation of the Tourism Development and Investment Company (TDIC), several ICBA scientists visited the island. The group was received by Mr Peter Oussoren, General Manager, who pointed out that ICBA and TDIC need to work together to conserve the island's native and introduced resources.

The exact relationship between TDIC and ICBA has yet to be finalized, but an initial scope of work that includes an analysis of the island's soils has been initiated.



*Collecting soil samples.*

### What exactly is saline water?

Various authorities measure water salinity differently. Some authorities classify the degree of salinity of mineralized water as follows in terms of parts per million (ppm). ICBA prefers to use deci Siemens (dS m<sup>-1</sup>). We use a conversion factor of 700 ppm to 1dS m<sup>-1</sup>, the accepted factor for the Middle Eastern region.

- **Slightly saline:** 1,000-3,000 ppm (1.4-4.3 dS m<sup>-1</sup>)
- **Moderately saline:** 3,000-10,000 ppm (4.3-14.3 dS m<sup>-1</sup>)
- **Very saline:** 10,000-35,000 ppm (14.3-50.0 dS m<sup>-1</sup>)
- **Brine:** >35,000 ppm (>50.0 dS m<sup>-1</sup>)



Evaluating water salinity in the low saline tank at ICBA – a key parameter for measuring water quality.

## STAFF NEWS

**Dr Rachael McDonnell** of Oxford University, UK, joined ICBA on 15 June. She will work initially as a Visiting Scientist in the areas of water policy and management. Dr McDonnell is a specialist in the links between the natural and social sciences in water management. She will take active role in the programs of ICBA's water research agenda.



In July, **Mr Eric McGaw**, Communications Specialist and the editor of this newsletter, left ICBA to take up a position with the Alliance for a Green Revolution in Africa (AGRA) in Nairobi, Kenya.

## Workshop in Bangladesh

The Bangladesh Agricultural Research Institute (BARI), in collaboration with ICBA, organized a one-day workshop on *Best management practices for sustainable crop production systems in coastal areas of Bangladesh* in Gazipur, Bangladesh, on 28 April. Mr Harun-ur Rashid, Director General of BARI, chaired the inaugural session. ICBA Irrigation Management Scientist Dr Nurul Akhand attended the inaugural session of the workshop as a special guest and presented a technical paper.

Results from the BARI-ICBA project were presented in the workshop, as were research findings from other research institutes and agencies such as the Bangladesh Rice Research Institute, the Bangladesh Institute of Nuclear Agriculture and Shagorika (an NGO). Eighty participants, including scientists, agricultural extension professionals, engineers and farmers attended the workshop. At the final session of the workshop, which was chaired by

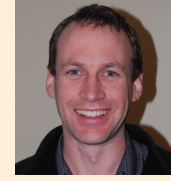
the Secretary of the Ministry of Agriculture, several recommendations for better management of water resources in the coastal belt of Bangladesh were adopted.





## Review of experiments with NyPa Forage™ (Yensen 4a) around the world

John Leake and Mark Sargeant, NyPa Australia Ltd



**D***istichlis* species were recognized as early as 1956 as grasses with potential for providing useful animal feed when grown in salt marshes (Nielson quoted in Hansen 1976). Dr Nicholas Yensen (1947-2007), a long-time ICBA collaborator, began working with *Distichlis spicata*, the variety with the most potential as ruminant feed, in the 1980s. He selected and patented a particularly vigorous cultivar of this plant in Arizona during the mid 1990s and introduced it into California and Arkansas in the US, and subsequently into Mexico, Australia, the UAE, Spain, Namibia and other hot dry countries (Yensen 1998).

He selected this cultivar of all the salt-tolerant plants he worked with due to its unusual combination of an efficient salt gland – one of the mechanisms it uses to sequester salt away from its growing cells as shown in the image to the right – and its deep and vigorous root growth, which gives the plant drought resistance and rebuilds soil structure and soil carbon.

He showed the plant to be distinctly different from other varieties of *Distichlis spicata* in that it does not respond to salt stress by shortening its internode length and stiffening its blades and stems to the same extent as the natural population in California. It also has broader, softer leaves (Yensen 2003).

Work by Sargeant (PhD dissertation in progress 2008) has shown that Yensen 4a can utilize additional N and P to form broader, more nutritious leaves even in conditions of higher salinity.

This article reviews some investigations that have shown



**NyPa Forage trials at ICBA. The ongoing collaboration between NyPa International and ICBA has been extremely productive.**

the economic and environmental benefits of this versatile plant. In Australia, NyPa Forage has been investigated in both dryland conditions and under irrigation with salty water.

The earliest work showed that the potential range of the plant is where saline water is available as groundwater between 1 dS m<sup>-1</sup> up to almost 1.5 times the salinity of ocean water (73 dS m<sup>-1</sup>)

within about 1m of the surface, although highest production may be where the water is below 30 dS m<sup>-1</sup>). The plants grow most actively in conditions where the temperatures are above 27°C, which is typical for plants with a C4 photosynthetic pathway. Although yield and quality vary significantly in these dryland conditions, Yensen 4a has been observed to yield well. Up to about 25 tonnes green matter (13.5 tonnes/ha dm) of forage with a crude protein content of between 5% and 17% and with a digestibility of between 45% and 60% (Leake et al. 2002).

More recent work by Sargeant has investigated the reasons for these variations and shown that the plant's genetic potential for productive nutritious animal feed is highly dependent on correct levels of plant nutrients, harvest time and harvest height, and that these feed values are maintained even in conditions of relatively high salinity.

High phosphorus and nitrogen supply were found to increase dry matter production separately. Surprisingly, high salt along with high phosphorus and nitrogen also improved feed quality. The high salt treatments improved the feed quality by increasing the leaf-to-stem ratio and crude protein concentration, and also decreased the acid detergent fibre concentration of the shoots. High nitrogen and phosphorus supply improved most measures of feed quality such as digestibility, leaf size, leaf-to-stem ratio and acid detergent fibre concentration (Sargeant 2008).

### Work at ICBA

Over the past 5 years, ICBA has tested NyPa Forage from a different perspective, using near-seawater and



**Salt 'whiskers' emerging from *Distichlis* salt glands.**  
(Photo: M Sargeant, La Trobe University, 2007)

seawater treatments with minimal management practices to evaluate its productivity, especially as a coastal management option. This work has included various salinity treatments, irrigation application rates (to leach salts when irrigated with seawater), sodium sulfate treatments and cutting frequencies. The latter treatment was undertaken to see if the fibre content of the material when grown for shorter periods would be lower without affecting the total annual biomass.

### Soil impacts

Sargeant has also shown that significant improvements in saturated hydraulic conductivity and aggregate stability are achieved with the growth of NyPa Forage. This was a result of comprehensive soil sampling conducted at Wickiepin, Western Australia, where the cultivar had been growing for 8 years in a degraded saline discharge zone. These results represent a significant finding for biosaline agriculture, which is often typified by very poor soil structure.

### Aquaculture

Work in Australia under irrigated conditions has focused on the plant's ability to strip nutrients from nutrient-rich saline effluent in land-based aquaculture, while simultaneously producing nutritious feed for livestock. These experiments, conducted by the Inland Saline Aquaculture group in Western Australia, point the way toward an important integration of biosaline agriculture and land-based fish production (Partridge 2007). These experiments showed that NyPa Forage removed up to 88% of total nitrogen and 95% of total phosphorous from aquaculture effluent over an 8-month period. More nitrogen and phosphorous were removed at higher nutrient levels. Higher salinity levels had a small inhibitory effect on the efficiency of phosphorous removal, but did not affect nitrogen removal. On the basis of these results, NyPa Forage appears much more suitable for nutrient removal from inland saline aquaculture effluent than the estuarine sedge species *Juncus kraussii* (Lymbery et al. 2006).

### Animal feed value

NyPa Forage was evaluated in terms of animal feed value by irrigating with saline aquaculture effluent and subjected to four different cropping regimes: 21, 42, 63 and 84 days. The best response was the 63-day regime, which gave a crude protein level of 15.3-18.2% and a metabolisable energy of 9.2-9.7 mJ/kg dry matter. This gives a feed equivalent to good quality hay or silage (Lymbery 2008).

### Work in the United States

The focus in the US has been on the ability of NyPa Forage to grow in nutrient-rich saline environments; including:



**NyPa nutrient stripping trial in saline water at the Murdoch University School of Veterinary Science, Western Australia.**

- Restoration of degraded oil-soaked land in Arkansas and Oklahoma (Yensen et al. 2002)
- Formation of part of a serial biological concentration system for saline irrigation drainage water (Cervinka et al. 1999)

### Conclusion

NyPa Forage (Yensen 4a) is a superior form of *Distichlis spicata* as a source of animal feed and has a wide potential range in hot dry areas of the world where saline water is available.

### References

**For further information, including complete references, contact John Leake at [jleake@nypa.com.au](mailto:jleake@nypa.com.au)**

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## ICBA campus expanding

ICBA's Strategic Plan for 2008-12 involves considerable expansion of the physical plant as well as the research agenda. The main thrust of recent work is to move laboratory equipment into new outer buildings to make room for additional offices. The new laboratories will be provided with sophisticated equipment capable of conducting highly professional experiments and analyses.



**New Central Analytical Laboratory**



**New storage facility**



(From page 1)

The inaugural session will culminate with a signing ceremony of the Statutes of the Academy, as well as Memoranda of Understanding between AWC and ICBA, between EAD and ICBA, and between all three organizations.

To further the aims of the Academy, a workshop on *Building human capacity for water management* will get under way after the inaugural session. The workshop, which will take place 6-8 July, will feature papers by several world-renowned experts in water management.

- *Outcomes of the February 2008 brainstorming workshop and areas for focus: examples from the field:* Julia Bucknall, Lead Natural Resources Management Specialist World Bank
- *Overview of the workshop and the way forward for the Arab Water Academy – strategy and directions:* Dr Shawki Barghouti, Director General, ICBA
- *Water leadership – present and future challenges for tomorrow's executives:* Prof Peter Rogers, Professor of Environmental Engineering and City Planning, Harvard University
- *Future water resources planning in the Arab states – challenges and opportunities:* Prof Tony Allan, School of Oriental and African Studies, University of London
- *Water and environment:* Dr Stephen Lintner, World Bank Senior Advisor

- *Water law – water leaders:* Prof Patricia Wouters, UNESCO Centre of Water Law, Policy and Science, University of Dundee, Scotland
- *Water governance:* Prof Chris Perry, Cranfield University, USA

The participants in the workshop will identify and design specific courses for the Academy as well as potential faculty, resource personnel, coaches and mentors.



**VIP visit: On 27 May, ICBA was graced by a visit from Hon Dr Waleed Al-Wohaib (center), Executive Director, Islamic Development Bank, and CEO of the International Islamic Trade Finance Corporation (ITFC). Dr Al-Wohaib was accompanied by Eng Hani Salem Sonbol (right), Deputy CEO, ITFC. The visitors were escorted around the campus by DDG Dr Ahmed Almasoum (left).**