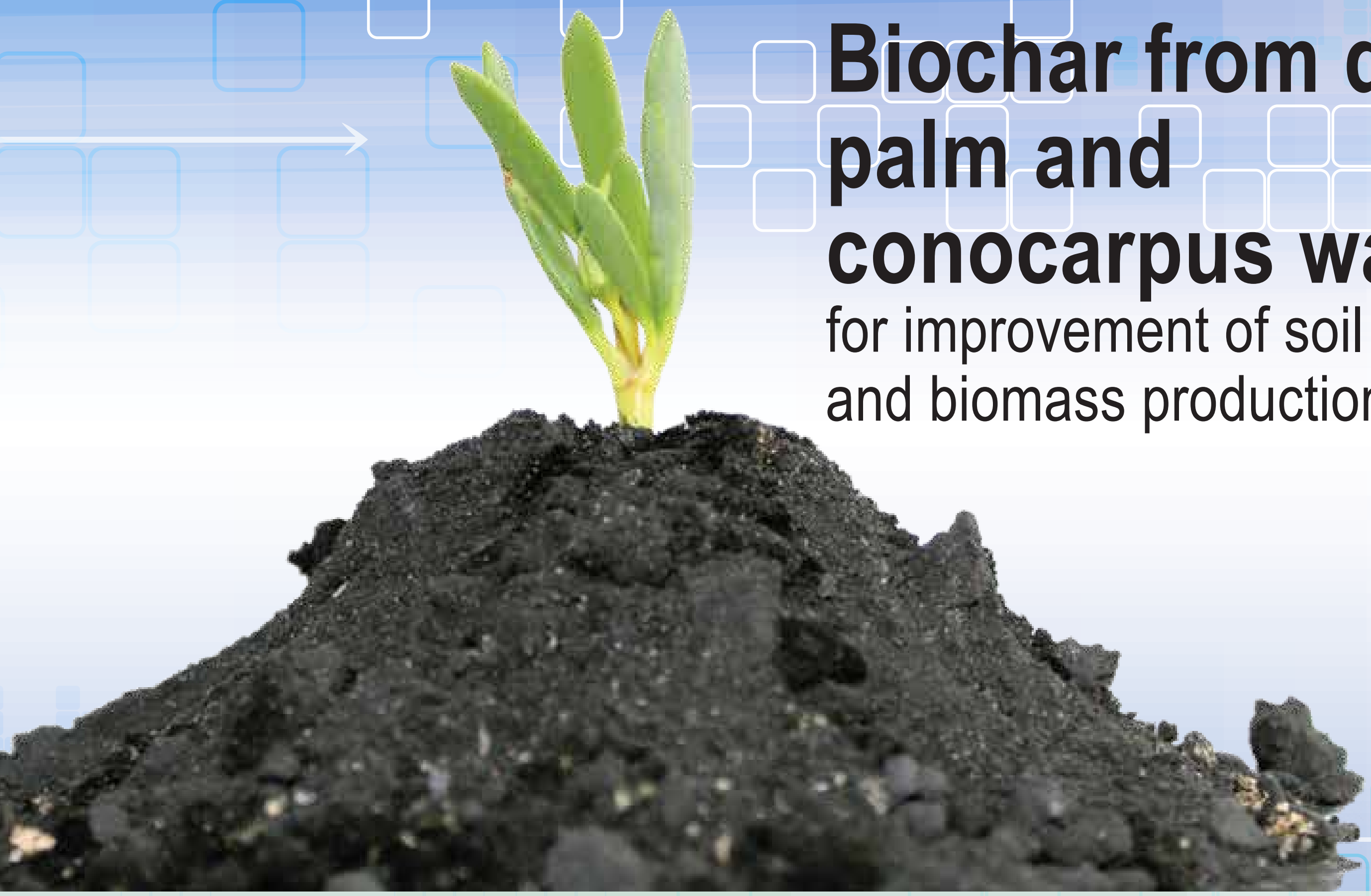
Biosalinity News



Biochar from date palm and conocarpus waste

for improvement of soil quality and biomass production

نزرع الغد
ICBA
AGRICULTURE FOR TOMORROW

ICBA Newsletter | Vol 15 | Issue 03 | December 2014
www.biosaline.org

2015

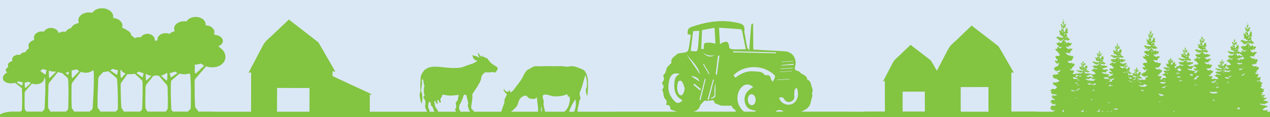
International Year of Soils

healthy soils for a healthy life

PROTECT OUR SOILS

Our soils are in danger because of expanding cities, deforestation, unsustainable land use and management practices, pollution, overgrazing and climate change.

The current rate of soil degradation threatens the capacity to meet the needs of future generations.



The promotion of sustainable soil and land management is central to ensuring a productive food system, improved rural livelihoods and a healthy environment

WE DEPEND ON SOILS

Source: Food and Agriculture Organization of the United Nations

Word from ICBA Director General

As this year draws to a close I would like to extend a warm thank you to all ICBA partners, stakeholders, collaborators, donors, employees, and friends for their continued support. Since 1999, ICBA has witnessed15 years of achieving great milestones that have had a significant impact on various water and agricultural policies across the region. During that period, we coordinated with national agricultural research centers and farmers' extension services centers in over 54 countries.

Moving ahead, ICBA continues its mission with a wider focus on ensuring a sustainable agricultural system that supports the food and nutritional requirements of future generations. ICBA's mission is to achieve food security in marginal and saline environments where it is needed most and to support small holder farmers and their families.

With the help of all ICBA's stakeholders we are moving on a steady path towards achieving sustainable agriculture for tomorrow. During 2014, ICBA focused on strengthening its existing partnerships and engaging new partners with active and forward thinking projects that will have an extended impact on the future of agriculture in marginal environments.

Our ICBA family is steadily growing and the center is actively pursuing expansion in various fields, especially at scientific and technical levels.

Currently we are working at revamping our existing website and would appreciate your feedback. Please feel free to send your comments directly to c.elkhouri@biosaline.org.ae

2015 will be the Year of the Soil!

ICBA has a long history with soil and the Center has dedicated a large portion of its work to soil related studies, which include: soil mapping, best soil management practices, and soil fertility and enhancement. We look forward to highlighting the various aspects of ICBA's work related to soil over the coming year.

I wish you an enjoyable read through this issue of Biosalinity News and all the best for the New Year 2015.

Sincerely yours,

Ismahane Elouafi

Cover page image: Biochar at ICBA research station; Photo credits: Charbel El Khouri

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Amaranth – Perspective as an alternative crop for saline areas

Amaranth grown at ICBA research station in Dubai

Amaranth (*Amaranthus* spp.), which belongs to the family Amaranthaceae, is an ancient food of the Aztecs and Mayans of Central America, and is now grown in many temperate and tropical regions. The genus Amaranthus comprises about 70 species, of which 40 are edible. All parts of the edible amaranth plant are suitable for eating. Furthermore, amaranth is very nutritional. The leaves are a good source of vitamins and minerals, i.e. leaves contain three times more vitamin A, calcium and niacin (vitamin B_3) than spinach, and 18 times more vitamin A, 13 times more vitamin C, 20 times more calcium and seven times more iron than lettuce (Guillet, 2004). Amaranth leaves show a significant energy value ranging from 27 to 53 kcal/100 g of fresh leaves and high nutrition value - in particular 4-6 g of protein, 0.2-0.6 g of fat and 4-7 g of carbohydrates. As for amaranth grain, it is high in fiber and low in saturated fats, whereby it contains 12% to 17% protein; moreover, Amaranth is an excellent source of lysine, which sets it apart from other grain crops (Kauffman and Weber, 1990).

In India and the Americas, amaranth is most often grown for its seeds, while in Southeast Asia and Africa, amaranth is grown as a leafy vegetable. In the United Arab Emirates (UAE), while *A. hybridus* and *A. caudatus* are occasionally cultivated, three other species namely: *A. albus*, *A. viridis* and *A. graecizans* grow as weeds in gardens and plantations though they are reportedly eaten in other parts of the world (see Mlakar et al. 2010). In recent years, there has been growing interest in Amaranth worldwide due to it being a highly nutritious gluten-free grain with many uses. Similar to other cereals, it can be used as a breakfast cereal and in making crackers, breads, cookies and other flour-based products. Cooked leaves are used as a side dish, in soups and as an ingredient in baby food, pasta, pie, and so forth.

Grain color variation in amaranth

Amaranth is a fast-growing crop that is adaptable to a wide range of soils and climates. It is also one of the few C_4 crop* species other than the grasses; thus, it performs well under adverse conditions, especially heat and drought. C_4 plants convert a higher ratio of atmospheric carbon to plant sugars per unit of water lost than those possessing the classical C_3 (Calvin cycle) pathway. In view of its tolerance to major abiotic stresses, amaranth has now emerged as a major climate resilient vegetable crop that not only fights climate change, but also fulfills the growing nutritional needs of human beings.

Heat and salinity are known to be the two major abiotic stresses impacting agricultural production in the Arabian Peninsula and elsewhere. Amaranth is reported to be moderately salt tolerant and compares well with other vegetable crops such as cowpea and mustard (Omami et al. 2006). However, most of the studies on salinity tolerance in Amaranth have been in pots under controlled greenhouse conditions and there is limited information on its performance under saline field conditions. Hence, the International Center for Biosaline Agriculture (ICBA) recently evaluated the performance of a few selected genotypes of two *Amaranthus* spp. (*A. cruentus* and *A. hypochondriacus*) under saline field conditions in Dubai.

Five genotypes (four of *A. cruentus* and one of *A. hypochondriacus*) previously selected for high yield potential from a set of 50 germplasm accessions received from the United States Department of Agriculture (USDA) were studied in a field trial laid out in a Randomized Block Design (RBD) with three replications. The irrigation treatments consisted of a control (EC_w 0.2) and three salinity levels with EC_w equivalent to 5, 10 and 15 dS m^{-1} obtained by mixing saline ground water with fresh water. Sowing was done in Mid-November. Each plot had four rows of 2.5 m and the distance between rows and between plants within each row were 50 and 25 cm, respectively. The plants were irrigated using the drip-system. Standard agronomic data were recorded from five randomly selected plants from the two middle rows within each plot. Analysis of variance was used to assess the effect of salinity, with the limit for statistical significance set at p=0.05.

** The terms C_4 and C_3 refer to the different pathways that plants use to capture carbon dioxide during photosynthesis. C_3 plants use the enzyme ribulosodiphosphatcarboxylase to fix CO_2 and the first product created is a 3-carbon molecule phosphoglycerate, while C_4 plants use phosphoenolpyruvate carboxylase to fix CO_2 and the primary product of photosynthesis is oxaloacetic acid.*

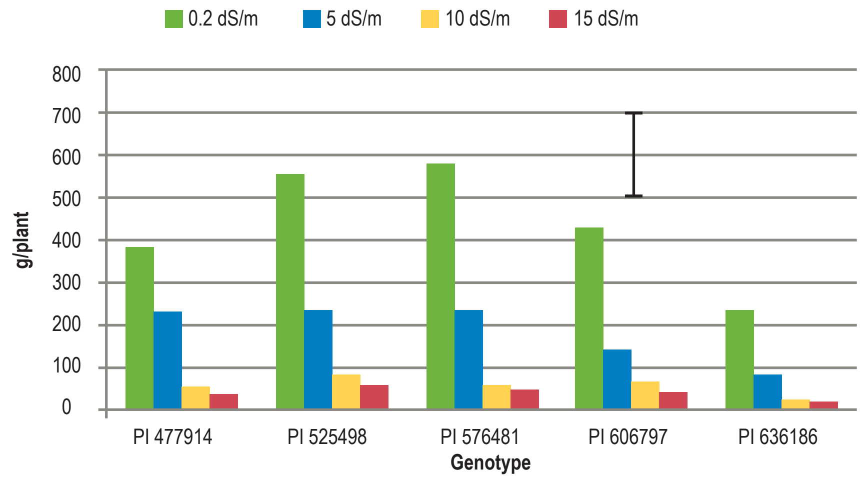

Figure 1: *Effect of salinity on green biomass production in five amaranth genotypes. The error bar represent the least significant difference (LSD) at P = 0.05.*

Analysis of the data showed that amaranth has good adaptation to the UAE environment, characterized by the hyper arid climatic conditions with limited supply of irrigation water and nutrient-poor sandy soils with low water holding capacity and high alkalinity. Current studies however indicate that amaranth performs well as a winter crop and produces high biomass and seed yields with non-saline irrigation water. Thus, based on a density of 16 plants/m^2, the estimated above-ground biomass yield in the non-saline control treatment was 69,280 kg/ha–much higher than the maximum reported yield of 49,000 kg/ha from favorable environments (see Mlakar et al. 2010). Similarly, the seed yield of 3,696 kg/ha obtained with non-saline water was close to the maximum reported yields of 3,800 kg/ha from Europe. Salinity stress however, significantly affected growth and productivity and the differences among genotypes were also highly significant (see Figures 1 & 2). However, the interaction between genotypes and salinity levels were not significant indicating that the response of the different genotypes to increasing salinity stress was about the same. Averaged over genotypes, increase in salinity from 0.2 dS/m (control) to 5 dS/m has decreased the mean plant height by 26%, stem thickness by 18%, number of branches by 28%, fresh biomass yield by 58% and seed yield by 79%. Further increase in salinity to 10 dS/m decreased plant height by as much as 52%, stem thickness by 46%, number of branches by 37%, fresh biomass yield by 87% and seed yield by 88%, compared to the control. In terms of genotypes, PI 525498 and PI 576481 produced the maximum biomass yields at all salinity levels. For seed yield, averaged over salinities, PI 576481 produced the maximum of 13.2 g/plant followed by PI 4477914 (9.2 g/plant) and PI636186 (8.6 g/plant).

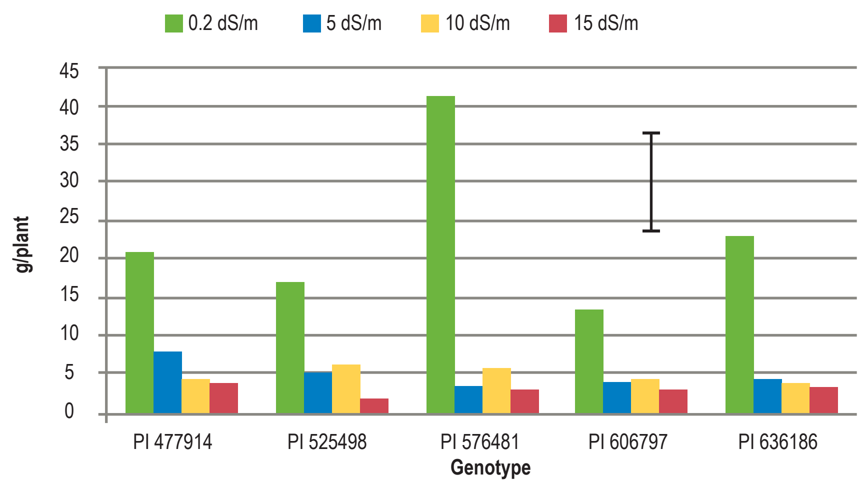

Figure 2: *Effect of salinity on seed yield of five amaranth genotypes. The error bar represent the least significant difference (LSD) at P = 0.05.*

In conclusion, results from this study showed that salt stress has more detrimental effect on seed yield than on the biomass yield and thus it is uneconomical to cultivate Amaranth in areas with saline water for irrigation. This is in contrast to the previous observations that mild to moderate salinity has no adverse effect on yield (see Omami et al. 2006; Costa et al. 2008) but as the number of genotypes evaluated in this study was small, further work on a broader range of genotypes is recommended to confirm this observation. Nonetheless, amaranth is still a promising new crop for non-saline areas that may prove instrumental in addressing the food security challenges of the future.

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Written and submitted by: Dr Nanduri K. Rao, Dr Mohammad Shahid

Integrated aqua-agriculture systems revisited

Water and food security constitute two of the most vexing challenges of the 21st century that humanity has to face. Rapid population growth, productive lands and fresh water limitations, high demand for energy, and climate change all contribute to limiting the agricultural capacity to meet demand for food, feed, fiber and fuel on a global basis. In order, to alleviate this pressure, scientists are looking for synergistic solutions among productive sub-systems that maximize farm productivity and minimize, in parallel, their ecological footprint. The integration of aquaculture components with agriculture provides a means to optimize the use of water resources and decrease dependency upon chemical fertilizers, while promoting greater sustainability of the systems.

The concept of Integrated Aqua-Agriculture Systems (IAASs) is not recent. Intensive IAASs have evolved from traditional extensive polyculture systems commonly found in African and Southeast Asian countries since the 1950s, where fish have been raised while simultaneously growing crops, usually rice. The well- known paddy cam fish cultures are very popular in Indonesia, China, Japan, Malaysia, Thailand, Vietnam, Bangladesh, Ivory Coast, Liberia, Madagascar, Tanzania, Zaire and others. Fish ponds are grouped around a village or near sources of irrigation water and are primarily used to raise fish for consumption by the producers.

IAASs are characterized by several advantages such as: a) farm productivity and profitability increases without any net increase in water consumption, b) farm diversification increases through higher value crops, including aquatic species, c) re-use of water and nutrients otherwise wasted on-farm resources, d) reduction of net environmental impacts of semi-intensive farming practices and e) higher net economic benefits due to offsetting existing farm capital and operating expenses. Apart from these benefits, there are social benefits associated with IAAS. so the operational requirements of IAASs are not gender, or age specific, so broad participation by the workforce (small-scale farmers) including women and youth is possible. In addition, water authorities may achieve multifold benefits through more efficient use of marginal waste resources such as saline groundwater. The result is increased revenue without increased consumption, further offsetting the existing management and maintenance costs.

Aquaponics constitute a modern type of IAASs which demonstrates a growing trend nowadays. It is a food production system that combines conventional aquaculture with hydroponics (cultivating plants in water) in a symbiotic and controlled environment. Water from an aquaculture system is directed to a hydroponic system where the by-products are broken down by nitrogen-fixing bacteria into nitrates and nitrites, which are utilized by the plants as nutrients. The water is then re-circulated back to the aquaculture system.

Small-scale reverse osmosis (RO) desalination systems are increasingly used by farmers in GCC countries to irrigate crops, but a key environmental issue is the safe disposal of the produced brine as the conventional disposal systems are expensive and unproductive. As a result, good management practices need to be formulated. For this reason, since 2013, ICBA is operating an IAAS at its premises, which uses both the desalinated and brine waters in a study that aims to make use of aquaculture waste into a resource with benefits to the environment and farmers.

The IAAS was established on over 2 ha of area at ICBA experimental station comprising of an RO unit with a capacity to generate 100 m^3/day of fresh water and 150 m^3/day of brine water. In addition, three tanks with a volume of 3000 gallons each used to raise fish with part of the brine water generated from the RO unit. The fish species *Sparidentex hasta* (sobaity seabream) introduced for aquaculture demonstrated remarkable adaptability to the local conditions, implying that the species is a good candidate for the IAAS. 1500 fish were raised in the three tanks (500 fish/tank). Within four month period, fish weight increased by 160% and fish length by

Salicornia growing on brine water; in the back appears the fish tanks (with green shades) and the water reservoirs for desalinated and brine water at ICBA research station

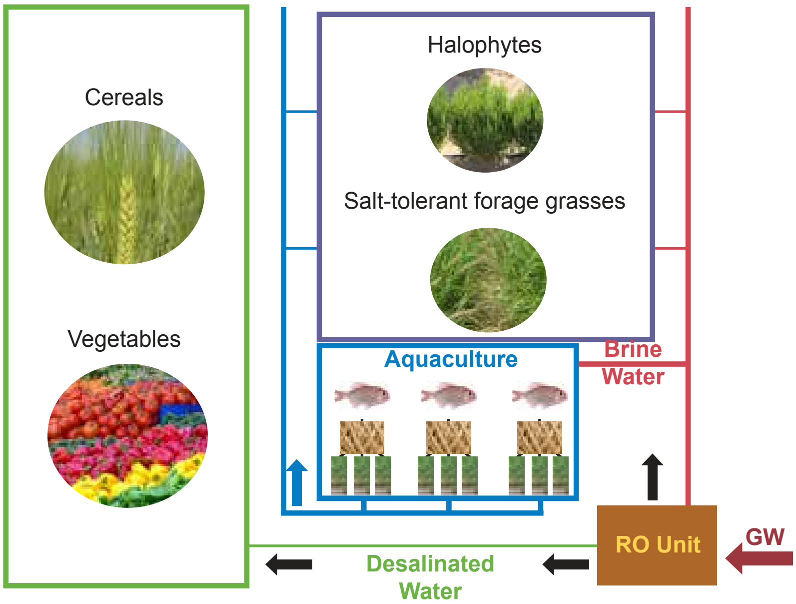

Diagram of the integrated aqua-agriculture system that is being implemented at ICBA research station in Dubai

50%. The desalinated water produced from the RO unit was used to irrigate several high value crops such as asparagus, maize, quinoa, eggplant and okra, where as the brine water from the RO unit, either solely or mixed with groundwater and the aquaculture effluents was used to grow different salt-tolerant perennial forages such as *Sporobolus arabicus*, *Distichlis spicata*, *Sporobolus virginicus*, *Paspalum vaginatum*. Selected *Salicornia bigelovii* populations were also evaluated under two water regimes (RO- and aquaculture-brine) and irrigation systems (bubblers, sprinklers). The bubble system was more efficient to enhance the performance of *S. bigelovii* plants compared to the sprinkler system. However, in both cases the brine water did not significantly impact growth.

Results from the first year show that such integrated systems can create a wealth of ecological and economic advantages in marginal environments ranging from sustaining environmental quality through productive use of brine and dissolved and particulate nutrients discharge, to generating value-added products such as such as fish, seaweeds, forages and vegetables. In this way, the sustainability of the existing RO infrastructures in the GCC region is enhanced. Cost benefit analysis will be carried to examine the economical feasibility of such a land-based IAAS in a marginal environment.

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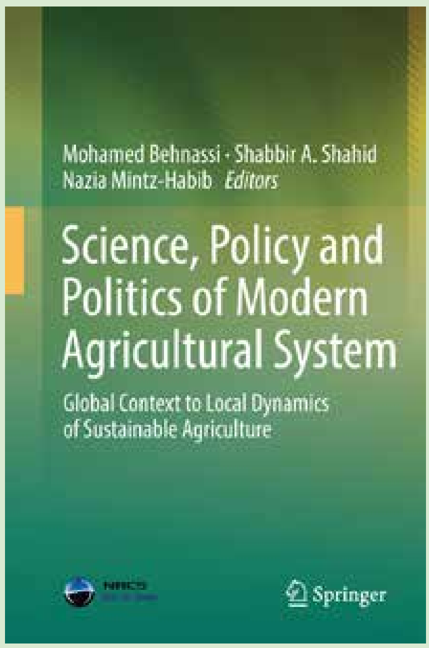
Written and submitted by: Dr Dionyssia Lyra, Dr Shoaib Ismail, Eng Khalil Rahman Butt, Eng Basel Al'raj

New Publication

Science, Policy and Politics of Modern Agricultural System Global Context to Local Dynamics of Sustainable Agriculture

The release of the book **Science, Policy and Politics of Modern Agricultural System – Global Context to Local Dynamics of Sustainable Agriculture** co-edited by Mohamed Behnassi (NRCS, Morocco), Shabbir A Shahid (ICBA, Dubai) and Nazia Mintz-Habib (University of Cambridge UK) is an outcome of international conference (ICCAFFE2011) held in Agadir (Morocco) 19-21 May 2011. The conference was jointly organized by the North-South Center for Social Sciences (NRCS) in collaboration with GIZ Germany and IRD France. Scientists from a wide range of specializations participated in the conference. The book presents 23 chapters distributed into four themes: sustainable agricultural development facing environmental, economic and social challenges; the impact of soil degradation in terms of agricultural productivity; livestock production enhancements: recommended techniques and agro-biodiversity, climate change and livelihood: managing interdependence. The book is an excellent source of scientific information to be used by a myriad of stakeholders, such as researchers and experts, professors and students, land use planners, decision makers, NGO actors, and politicians.

Publisher: Springer (2014)
ISBN: 978-94-007-7957-0



Biochar for improvement of soil quality: A comparative study

Biochar is a solid fine-grained material obtained from the carbonization of biomass under oxygen-limited conditions. Biochar may be applied directly to soils to improve soil functions and to reduce emissions from biomass. Due to its stability, biochar has an important role in carbon sequestration (the process of capturing CO_2 before it escapes into the atmosphere).

This 2,000 year-old practice converts agricultural waste into a soil enhancer that can hold carbon, boost food security, increase soil biodiversity, and discourage deforestation. The process creates a fine-grained, highly porous charcoal that helps soils retain nutrients and water. Biochar is found in soils around the world as a result of vegetation fires and historic soil management practices. Intensive study of biochar-rich dark earths in the Amazon (terra preta), has led to a wider appreciation of the unique properties of biochar as a soil enhancer.

Conceptually, three main mechanisms have been proposed to explain how biochar might benefit crop production, i.e., direct modification of soil composition through its elemental and compositional make up, providing chemically active surfaces that modify the dynamics of soil nutrients, and also modify the physical character of the soil in a way that benefits root growth and/or nutrient and water retention.
The use of Biochar has been reported to improve the physical and chemical properties of soils as it contributes to increased cation-exchange-capacity (CEC) which affects the ability of soils to hold nutrients, increase nutrient uptake, and decrease nutrient losses through leaching. The effect of biochar on crop yield has been assessed for its moisture retention capacity. The result is a reduced need for frequent irrigation of crops. In order to assess the quality of biochar to use in agriculture, seven parameters are important; pH, volatile compound content, ash content, water holding capacity, bulk density, pore volume, and specific surface area. In general, the carbon content of biochar is inversely related to biochar yield. Increasing pyrolysis temperature from 300 to 800°C decreased the yield of biochar and increased the carbon/ash content.

The color of biochar from conacurpus (left) is dark black and biochar from date palm (right) is grayish black

In recognition of the importance of biochar in improving soil properties and crop yield, ICBA has produced biochar from two sources: 1) date palm and 2) conocarpus. The plant materials were shredded into smaller pieces that were combusted in a furnace separately at two different temperatures (350 and 400°C). At the completion of combustion, the plant material was converted to very fine black powder (biochar). Prior to the use of biochar in greenhouse experiments, its characteristics

Table 1: *Characteristics of biochar produced at ICBA at two temperatures using conocarpus material*

Pyrolysis temperature→	350°C	400°C
Parameters↓		
Electrical conductivity (mS cm-1)	3.23	4.25
pH	9.20	10.57
Ash (%)	6.16	7.25
Color	Black	Black

Table 2: *Characteristics of biochar produced at ICBA at two temperatures using Date palm material*

Date palm→	Leaves		Stem		Twigs	
Pyrolysis temperature→	350°C	400°C	350°C	400°C	350°C	400°C
Parameters↓						
Electrical conductivity (mS cm^{-1})	4.97	6.70	11.30	12.50	20.70	24.50
pH	9.19	10.90	10.29	11.10	10.91	12.07
Ash (%)	8.71	9.20	11.25	12.71	17.57	18.15
Color	Grayish Black	Grayish Black	Grayish Black	Grayish Black	Grayish Black	Grayish Black

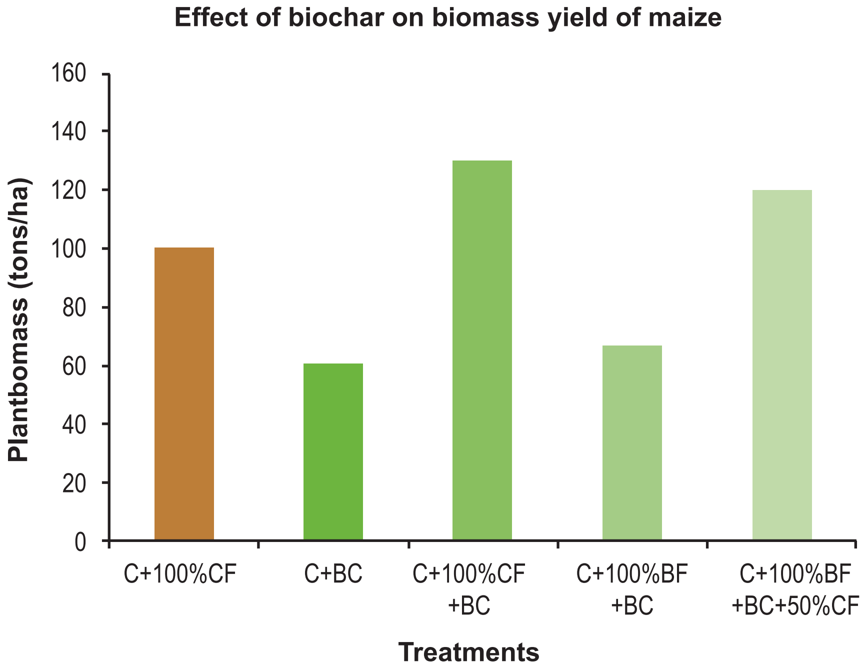


Figure 1: *Effect of biochar on biomass yield of maize*

were established in the laboratory. The pH, and EC was measured on 1:1 (biochar: water) suspension using pH and EC meter respectively. Ash content was determined through combustion at different temperatures, and difference in weight was used to calculate ash content. The present study showed similar trend (Tables 1 and 2), as shown by Al-Wabel et al 2013) for high EC, pH and ash contents at high temperature (400°C) relative to low temperature (350°C) in biochar prepared from conocarpus. The increase in pH at higher temperature is due to the loss of functional groups and hence alkalinity increased. In the absence of facility for elemental analyses, such tests have not been performed.

The obtained Biochar was used in a "Comparative Study on the Use of Biochar, Compost and Biofertilizers for Maize Crop in Sandy Soil." A greenhouse pot experiment (maize) was conducted on sandy soil (*Typic torripsamments*) dominant in the UAE. Following this, treatments were prepared and mixed in soil. The pots were then filled with soil. Ten maize seeds were sown in each pot. Each treatment was triplicated.

Results demonstrate (see Figure 1) that the addition of biochar at a rate of 5 ton/ha to conventional practice (100% chemical fertilizer) increased fresh biomass (29%), while the reduced rate of fertilizers application (50%) with biochar and biofertilizer increased biomass (19%) compared to conventional fertilizer rate alone. It is therefore concluded that the biochar, when used with the recommended rate of chemical fertilizer, produces more biomass yield. These are the preliminary results and need further confirmation in the field.

Further literature

Biochar use in soil (http://www.biochar-international.org/biochar/soils).

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Written and submitted by: Dr Abdullah Alshankiti and Dr Shagufta Gill

Comparative response of compost, biofertilizer, and biochar on maize biomass

Low cost compost production technology: Beneficial uses of compost and its product fulvic acid

There are growing global concerns regarding the excessive use of chemical fertilizers, atmospheric pollution, soil health, and biodiversity, resulting in an increased interest in organic recycling practices. The transformation of on-farm green waste (planting materials/organic waste) through microbial decomposition into a farm resource is called composting and the final product is "compost". To meet growing global population, there is a dire need to increase agricultural production The use of compost (organic matter) in agriculture fields offers many benefits such as enhanced soil fertility and subsequent increased agricultural productivity (Leifeld et al., 2001), improved soil biodiversity and reduced ecological risks by reducing landfill sites, NH_4 volatilization and NO_3 leaching to ground water. Not only the composts, but their components like humic acid and fulvic acid can have important bearing on improving plant growth at different developmental stages including seed germination and seedling vigor.

In addition to agricultural farming, the creation of green landscapes in urban planning projects is a prerequisite as they provide aesthetic and eye-catching views, create platform for healthy exercises, conserve biodiversity and sequester carbon. A healthy landscape requires soil without pollutants and with a mix of organic material, thus the use of the compost is one of the options to improve the quality of the landscape base. Usually 3-5 kg/m^2 or variable quantities (based on soil type and plants) of compost is mixed manually or mechanically for sustainable landscaper sites. The maintenance of these landscapes generates huge quantities of green waste which can be recycled to compost, thus provides environmentally friendly way of waste handling.

The main objective of this study is to provide an on-farm low cost compost production technology to aid the farmers and landscape developers to transform the green waste to a valuable resource.

Considering the beneficial uses of compost and of recycling green wastes, scientists at ICBA initiated a study that aimed to establish a low cost on-farm compost production technology and evaluate the benefits of the

Figure 1: *Low cost compost production technology at ICBA*

***Table 1:** Effect of various concentrations of fulvic acid (0.5 to 1%) on seed germination and traits**

Treatment*	% germination (mean±SD)	Speed of germination (mean±SD)	Accumulated speed of germination (AS) (mean±SD)	Coefficient of rate of germination (mean±SD)
Prosopis cineraria				
Control	73.33±11.54	0.53±0.24	1.1±0.09	30.15±2.7
Fulvic acid 0.5%	93.33±11.55	0.56±0.17	1.61±0.19	33.82±3.8
Fulvic acid 1%	100±0.00	1.19±0.26	3.00±0.44	52.65±8.8
Acacia tortilis				
Control	73.33±11.5	5.8±0.08	1.61±0.37	35.20±3.8
Fulvic acid 0.5%	83.33±0.00	0.81±0.17	2.25±0.38	40.92±4.9
Fulvic acid 1%	93.33±11.55	1.06±0.12	2.72±0.34	51.85±3.2

*the mean and standard deviation is for three replicates

compost product 'fulvic acid' in improving seed germination. Therefore, a low cost on-farm compost production system was set up at the experimental station (Figure1) using the feedstock derived from plants clippings (grasses, shrubs, ground cover and trees, etc). At ICBA the green waste is available once a week in summer (March - September) and fortnightly in winter (October - February). Among the three composting methods (windrows composting piles, static piles, bins) static pile composting method was used, where green waste material was piled, moistened (50-60%) and covered with polyethylene sheet to reduce moisture loss. During the first week the temperature ranged between (30-40°C), after fortnight it increased to (50- 60°C) for a week and then maintained at (30-40°C). The material was manually aerated (turning every alternate day). The microbial inoculation hastens the composting (Nair and Okamitsu, 2010; Ghaffari et al., 2011), therefore, we inoculated the material with a consortium of microorganism (fungi, actinomycetes, mycorrhiza, trichoderma and bacteria), resulting into (aggregation-adhesion polysaccharides) stable and mature compost consisting of organic matter (38.2%), C/N 36:1, P (0.27%), K (0.75%), pH (7.7) and moisture (<10%).

Priming of Seeds with Fulvic Acid The *Prosopis cinerarium* and *Acacia tortilis* are important native trees of UAE and the seeds are poorly germinated. In an attempt to increase seed germination, the seeds were primed with fulvic acid (0.5 and 1%) extracted (Asing et al 2014) from compost prepared at ICBA, and seed germination trial in the green house was conducted.

Present study concludes that it is possible to establish a low cost compost production facility at the farm scale level using the green wastes which otherwise goes to landfills. Such an establishment leads to beneficial uses of compost to enhance soil fertility, soil structure development and biological population essential for plant growth. Further to the direct beneficial uses of compost, its product, such as fulvic acid extracted from the compost can significantly improve seed germination and traits of native plant species (*Prosopis cineraria* and *Acacia tortilis*) that usually take long time to germinate (Table 1). This has consequences on the faster establishment of nurseries and rapid rehabilitation of desert lands with the native trees.

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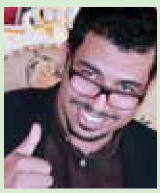
Written and submitted by: Dr Shagufta Gill and Dr Abdullah Alshankiti

Announcement

New ICBA members

Setta Tutundjian
Director, Partnerships and Knowledge Management

Asad Sarwar Qureshi
Irrigation/Water Management Scientist



Abdelaziz Hirich
Post Doctoral Fellow

Sijimon Chamavalappil
Driver

Plant genetic resources vital for food security and sustainable agriculture

Forum on «The Role of Global Plant Genetic Resources for Food Security and Sustainable Agriculture in the Middle East» at ICBA, Dubai, 11 November 2014

Representatives from 17 national and regional agricultural research, and government institutions gathered at ICBA headquarters to discuss how plant genetic resources can contribute to increasing agricultural productivity, food production and food self-sufficiency in the Middle East. The forum also tackled how agriculture can adapt to a changing climate so as to build a sustainable and resilient food production system in the region, by drawing on available crop diversity.

The key priority areas that were identified during the panel discussion included: identifying the challenges agriculture is facing; advancing the understanding of politicians; understanding decision makers and the general public's role in plant genetic resources for building resilient and sustainable agricultural systems; promoting better nutrition and providing food security; and finally, increasing the financial resources available for plant genetics.

Moving forward the participants agreed on the need to create a unified message from all organizations that will represent a collective voice which communicates one main theme, and support this message with strong economic figures.

"My suggestion on this topic is that the organizations involved need to come together and develop an overall communication plan, that not only identifies this overarching one message, but also identifies the role of each organization and the activities it will carry", said Setta Tutundjian, Director, Partnerships and Knowledge Management (PKM) at ICBA, who added "This will encourage coordination of efforts to increase impact."

"We hope that this will continue to raise awareness of policy makers in this region about the importance of conservation of crop diversity", said Luigi Guarino, Senior Scientist at Crop Trust; who added, that the conservation and use of crop diversity could help in making agriculture more sustainable regionally and globally vis-à-vis increasing stresses, mainly climate change.

The event, held on 11 November 2014, was organized by the Global Crop Diversity Trust (Crop Trust) and the International Center for Biosaline Agriculture (ICBA).

Agricultural Innovation Center in Sharjah, UAE

H.E. Dr. Rashid Ahmed Bin Fahad, Minister of Environment and Water, inaugurated, on 17 December 2014, the Agricultural Innovation Centre (AIC) in Al-Dhaid, Sharjah, aimed to promote latest agricultural advancements and maintain the agricultural sector's sustainability in the UAE through state-of-the-art technological innovations, research works, and relevant consultations.

AIC will coordinate with international centers specializing in agricultural technologies through the execution of joint scientific research and partnership programs and schemes to develop the UAE's agricultural system.

H.E. Dr. Rashid Ahmed Bin Fahad during the inauguration tour of AIC; on his left hand side, Dr. Ismahane Elouafi, Director General of ICBA, 17 December 2014

Speaking on the occasion, Bin Fahad said the AIC falls in line with UAE Vision 2021, which is inspired by the National Work Program of President His Highness Sheikh Khalifa Bin Zayed Al Nahyan, and aims to position the UAE as one of the world's best countries by 2021.

AIC further aims to reinforce research in various agricultural applications and segments, including modern innovative technologies, to address the numerous requirements and challenges of modern agriculture. It aims to promote cooperation and exchange of expertise among concerned local authorities and relevant regional and international research centers in the UAE and the rest of the world.

One of the strategic partners for the Agricultural Innovation Center is the International Center for Biosaline Agriculture, which works jointly with AIC in various joint studies covering local agricultural segments, such as a study on the effects of multiple levels of salinity on the production of some salinity-tolerant agricultural and pastoral crops.

Managing salt affected soils in Ethiopia

Land degradation due to soil salinity in the irrigated areas of Ethiopia is considered one of the main soil constraints and a severe problem for the growth of agriculture and food security of the country. To discuss various potential solutions , the Ministry of Agriculture in Ethiopia and the International Center for Biosaline Agriculture (ICBA) co-organized a workshop that gathered together 22 representatives from the Ethiopian national research and development organizations, private sectors, regional and international development partners; and key donor agencies. The workshop titled "Managing Salt Affected Soils in Ethiopia." was held in Addis Ababa on 11-12 December 2014 and produced several key recommendations.


«Managing Salt-Affected Soils in Ethiopia» workshop held at Addis Ababa, Ethiopia, 11-12 December 2014

First, the Ethiopian Ministry of Agriculture and ICBA will lead the initiation of a five-year project that will oversee both mitigation and adaptation project activities in order to rehabilitate the salt affected farms back to production. The major component will be working on forage-livestock integration systems along with applicable technologies in these salt affected farms through collaboration with the International Livestock Research Institute (ILRI) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). After testing these integrated systems, the project will work on scaling-up applicable activities targeting 1 million hectare during the five years period. Training on the management of salt-affected lands and preventive measures to reduce soil salinization in irrigated lands will be a major component under the new projects as will be the development and implementation of policies and strategies.

ICBA awarded two grants for young scientists

ICBA was recently awarded two grants under the Young Water Scientist Partnerships (YWSP) Small Grants Program for the Middle East and the North Africa Network of Water Centers of Excellence (MENA NWC) to collaborate with Arabian Gulf University in Bahrain and International Water Management Institute respectively. Funding for these research projects that will be carried over the next 12 to 15 months is by the United States Agency for International Development (USAID).

The "Improving agricultural soil properties using soil amendments to enhance water and nutrient use efficiency for crop production in dry lands and assessing these efficiencies via remote sensing techniques" research project will be carried by Dr. Henda Al-Mahmoudi (ICBA) and Dr Ali El Battay (AGU). The aim of the project is to improve the resource capacity of the soils using soil amendments and assess efficiency through remote sensing techniques. This will yield better and more cost-effective crop production. This research aspect is very important especially for Arabian Peninsula countries where the soils are sandy in nature (low nutrient and water holding capacity, high infiltration rate) and require high inputs to produce crops. The use of soil amendments might enhance crop productivity in sandy soils and decrease water consumption. Remote sensing techniques will help to assess the efficiency of amendments on soil and crop production. Results and technologies from the study might even prove to be transferrable to other countries with similar conditions to the Arabian Peninsula.

The research project, "Improving economics of using saline water in arid and semi-arid areas through integrated aqua-agriculture systems (IAASs)" will be carried by Dr. Dionyssia Lyra (ICBA) and Mr. Javier Mateo-Sagasta (IWMI). The study will mainly focus on the economic aspect of the IAAS that has been operating at ICBA headquarters since 2013 and uses desalinated and brine water (by-product) from a reverse osmosis (RO) unit. The project will address the challenge of transforming this by-product into a resource through IAAS with benefits for the environment and farmers. The agronomic performance, costs and potential revenues from the freshwater and brine-fed IAAS will be reviewed to analyze the potential for replication and scaling out.

Through this project, the combined activities of IAAS will generate opportunities for business for farmers in arid and semi-arid areas. Their income could be increased through reduction of costs (water recycling, aquaculture effluents enriched with nutrients) and yield increase from various sources. In addition, the safe disposal of saline wastewater (brine) water through its recirculation for combined aquacultural and agricultural purposes can constitute a more environmentally feasible and friendly solution, securing people's health and environmental sustainability.

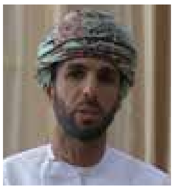
Investigation of seawater intrusion and inter-relationships between aquifers using integrated approach of isotopes and conventional techniques

Certificates distribution during the closing ceremony of the ICBA and IAEA workshop, 11 September 2014

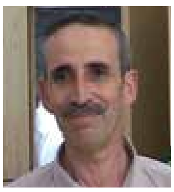
Twenty participants from Iraq, Jordan, Oman, Syria, UAE, and Yemen completed a five-day training course on 'Investigation of Seawater Intrusion and Inter-relationships between Aquifers Using Integrated Approach of Isotopes and Conventional Techniques'. This training was organized by the International Center for Biosaline Agriculture (ICBA) in collaboration with the International Atomic Energy Agency (IAEA) in Dubai, from 7-11 September 2014.

The trainers included Mr Umaya Doss Saravana Kumar (KISR, Kuwait), Mr Kamel Zouari (Tunisia), and Dr Khalil Ammar (ICBA). Basic concepts of hydro chemical, hydro-geological and isotopic techniques applied to address groundwater salinization problems with special emphasis on seawater intrusion were included. A hands-on approach was used in addition to theory. Dr Ismahane Elouafi, Director General of ICBA, expressed ICBA's pleasure in organizing such a course and focused on the importance of having highly technical training in science and technology since they bring hope for a better future in marginal environments. Dr Elouafi emphasized the need for substantial investment in science and technology and the importance of having more opportunities to share and debate acquired knowledge.

Participants' feedback



The workshop we participated in was an excellent workshop using the isotope to study the salt intrusion and intermixing between different aquifers; we learned a lot. We would like to thank ICBA for hosting the workshop and for IAEA for sponsoring our participation. ***Talal Khalifa Sail Al Hosn, Oman***



This workshop was very effective and enriching especially with regards to our work back home in tackling environmental issues related to water scarcity. The learning environment was very good and we thank the organizers for their professional work in putting this course together. ***Zeyad Qawasmeh, Jordan***

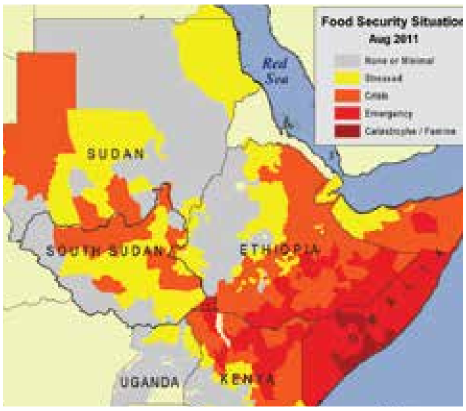
I would like to thank ICBA for holding this course. This course was excellent regarding seawater intrusion. I am glad to be here in Dubai and taking part of this course. ***Amal Alsayaheen, Jordan***

I feel proud of participating in this workshop. I fully benefited from the highly experienced and talented trainers. In general this course was a great success and I thank ICBA represented by Dr Ismahane Elouafi and the IAEA for funding this course. Special thanks to the UAE in general and Dubai in particular for their warm hospitality. ***Abdulmuneem Al-Areqi, Yemen***

Seminar on 'Sustainable Intensification' by Shenggen Fan at ICBA

Drylands constitute more than 40% of the world's cultivated systems and the livelihood of 2 billion people depends on drylands. However, high land and water constraints along with climate change with its increased frequency and intensity of extreme weather events especially recurring drought spells not only threaten food and nutritional security in these areas but culminate into severe food crises and rising food prices. All of these critical aspects were the focus of a seminar on the "Sustainable intensification is key to food security and nutrition in drylands" by Dr Shenggen Fan, Director General of International Food Policy Research Institute (IFPRI).

Dr Fan, visited the International Center for Biosaline Agriculture (ICBA) on 12 November 2014, and part of his visit included the seminar hosted by ICBA which



Source: USAID 2011

gathered representatives from local universities, government entities, and international organizations.

The seminar by Dr Fan highlighted how sustainable intensification, producing nutritious foods with efficient use of input and natural resources on a durable basis, is an important step to improving food security and nutrition in drylands.

Integrated solutions to advance sustainable intensification were addressed. These include increasing both crop and livestock productivity; providing adaptive buffers against emerging challenges; improving resource-use efficiency; and diversifying livelihoods, thereby enhancing resilience for better food security and nutrition in drylands.

Dr Shenggen Fan given a trou of ICBA research facilities and farm by Dr Shoaib Ismail, Director of Research and Innovations at ICBA

ICBA trains local government staff

ICBA conducted two specialized training programs for the staff of the Ministry of Environment and Water (MoEW) in the United Arab Emirates, where more than 30 participants have participated in: 'Production and Utilization of Forage Crops in Marginal Environments' and 'Specifications and Standards of Non-Conventional Water Resources'. These courses are part of a series of joint training programs between MoEW and ICBA.

The production and utilization of forage crops in marginal environment program covered:

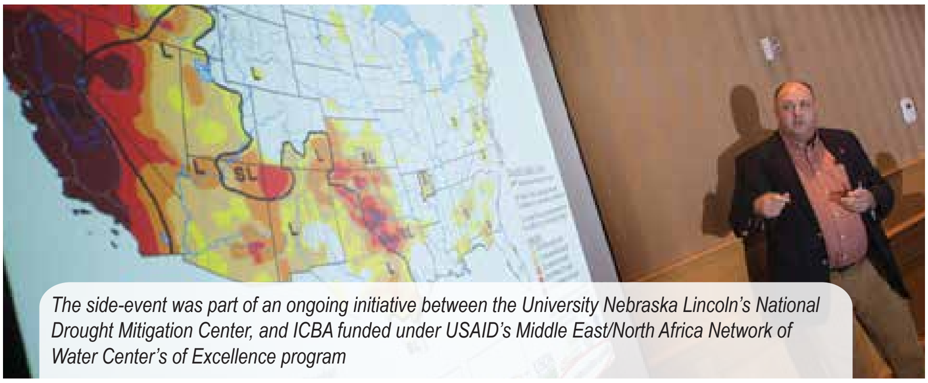
- Integrated approaches to crop production under marginal conditions
- Non-conventional forage crop resources, production and propagation
- Major crop and forage production systems in the UAE
- Rehabilitation strategies for salt-affected farms in the UAE
- Sustainable production, management and utilization of non-conventional forage crops
- Irrigation management for water productivity in field and forage crops
- Hands-on-training on salt-tolerant crops propagation

While the course on specifications and standards of non-conventional water resources covered:

- Integrated water resources in the UAE–conventional and non-conventional
- Crops water demand and irrigation scheduling
- Innovative irrigation technologies
- Alternative crops for marginal lands
- Environmental impacts of non-conventional water resources
- Hands-on-training on irrigation scheduling

ICBA has been involved since its establishment 15 years ago in supporting the development of national and international resources in the fields of agriculture in marginal environments using marginal water resources.

Drought monitoring and early warning systems: The possibilities and challenges in harnessing the data revolution



The side-event was part of an ongoing initiative between the University Nebraska Lincoln's National Drought Mitigation Center, and ICBA funded under USAID's Middle East/North Africa Network of Water Center's of Excellence program

Drought affected many parts of the world in 2014. In light of this, the possibility of harnessing data to develop drought monitoring and early warning systems was the focus of an event run by ICBA's MAWRED[1] project. The event was held at the Water for Food Global Conference in partnership with USAID[2], NASA[3], and the University of Nebraska Lincoln National Drought Mitigation Center. Presenters and approximately 55 attendees from various countries shared their experiences. With drought monitoring being a growing area of importance, data revolution offers great possibilities that can help focus early management efforts and disaster relief.

Drought continually impacts water and food security in Jordan, Palestine, Lebanon, China, Australia, Central Africa, and California bringing loss of lives, and millions of dollars of economic devastation. Managing the impacts of drought is complex. Challenges include the provision of disaster relief, responsibilities and governance across agencies and financing activities. Whilst monitoring and early warning systems are possible, they require a sometimes difficult marriage between a) earth observation and dynamic modeling and b) user communities at both policy and field levels. With predicted increases in drought in some of the world's major crop production areas, it is important that the challenges and possibilities are explored to support water and food security initiatives.

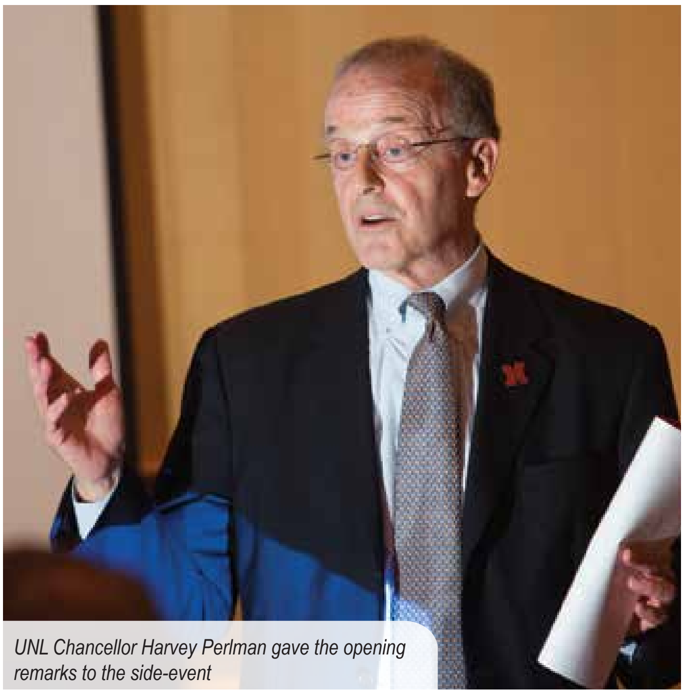
The discussions and presentations highlighted experiences from different countries and regions in establishing drought monitoring and early warning systems. The possibilities and challenges in developing these systems utilizing newly available data sets from satellites and models were examined, including ICBA's work through the MAWRED program in the Middle East and North Africa region. The importance and best practices in ensuring systems were both user-led as well as technology-led endeavors were emphasized to ensure local ownership and so adoption. Key questions addressed included those on sustaining these systems beyond the initial project development phase.

[1] MAWRED- Modeling and monitoring Agriculture and Water Resources for Development

[2] USAID: United States Agency for International Development

[3] NASA: National Aeronautics and Space Administration

Dr Rachael McDonnell, head of the MAWRED project at ICBA



UNL Chancellor Harvey Perlman gave the opening remarks to the side-event

Ther Farmers' Field Day was part of the collaboration project between ICBA and ADFSC. The project worked at rehabilitation of abandoned farms in the Western Region of Abu Dhabi Emirate through introduction and adaptation of alternative forage crops with soil and water management.

Farmers' field day: Salt-resistant fodder in the «Western Region»

The International Center for Biosaline Agriculture (ICBA) in cooperation with Abu Dhabi Farmers' Service Centre (ADFSC) held a 'Farmers Field Day' in a model demonstration farm in Ghayathi, which focused on best farm management practices for agricultural in saline affected lands and using saline water and salt-tolerant crops.

The ADFSC was established in 2009 by the Abu Dhabi Agriculture and Food Safety Authority (ADAFSA) and implemented by the GRM International to facilitate a change in the way agriculture and agribusinesses are conducted in the Western Region of the Abu Dhabi Emirate. The ADFSC acts as a link between the Abu Dhabi Government and the farming community.

At the Farmer's Field Day, ICBA showcased salt-tolerant alternative crops that could replace the high fresh water consuming Rhodes grass. Expert trainers informed farmers on alternative feed that can be grown in saline soils, have high production rate, and low water consumption. In addition, the demonstration farm displayed a new automatic irrigation system, which was supported by a mini meteorological station to remotely track and factor the climatic conditions.

Perennial salt-tolerant fodders have lived for over 10 years now at ICBA experiment fields and with the right water and soil management, soil salinity were maintained although irrigation used high saline water. In addition, these fodders have high sustainable nutritional value for livestock and high level of production where the biomass could reach 30-35 tons/hectare/year.

Dr Shoaib Ismail, Director of Research and Innovations at ICBA, during his opening speech of the farmers' field day

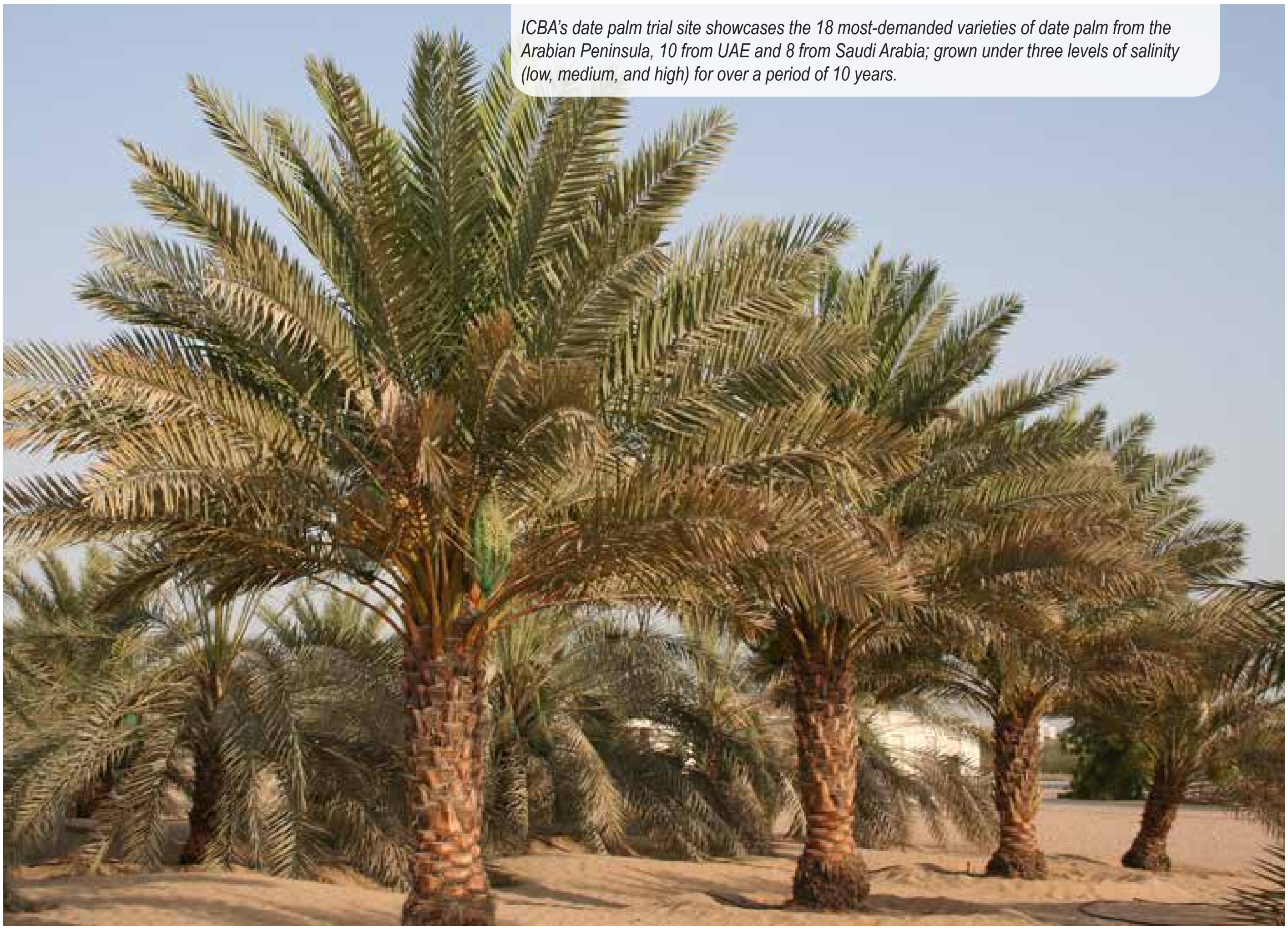
Emirates International Date Palm Festival: ICBA highlights 12 years of date palm research

There was big interest in ICBA's research on date palm and forage crops from visitors from the region to the Emirates International Date Palm Festival according to Ghazi Al-Jabri, Training and Events Coordinator at ICBA. The event this year was held under the patronage of H.H. Sheikh Mansour Bin Zayed Al-Nahyan, Deputy Prime Minister of the UAE, Minister of Presidential Affairs and Chairman of Abu Dhabi Food Control Authority (ADFCA) and attracted more than 25,000 visitors. It included popular features like traditional theatre and kitchen, kids' workshop and playground, date tree climbing, date tree planting, date tasting oasis and date museum.

The Emirates International Date Palm Festival was an opportunity to show ICBA's research on date palm irrigated with wastewater as well as treated wastewater among the local, regional and international exhibitors and visitors. It was a good venue to promote ICBA's research in general and on forage crops in particular that can be grown in integrated systems with date palm plantations.

Mr. Al Jabri along with his colleague Eng. Abdul Qader Abdul Rahman, who were both present at the ICBA exhibition stand, highlighted ICBA's ongoing 12 years date palm research that aims to test the affects of saline water (mainly ground water) on maturity and productivity of these varieties as well as determine the proper management packages including the amount of water required by the tree. It is worthwhile to mention that recently ICBA started an experiment to evaluate the affect of treated wastewater on date palm trees.

Ghazi Al-Jabri, Training and Events Coordinator at ICBA, during the 2014 Emirates International Date Palm Festival



ICBA's date palm trial site showcases the 18 most-demanded varieties of date palm from the Arabian Peninsula, 10 from UAE and 8 from Saudi Arabia; grown under three levels of salinity (low, medium, and high) for over a period of 10 years.

ICBA Board of Directors inspects ICBA's impact on agriculture in marginal lands

The International Center for Biosaline Agriculture (ICBA) was honored to host its Board of Directors on 19-20 November 2014 at the Center's headquarters in Dubai. ICBA Board of Directors includes internationally renowned scientists and leaders in the areas of agriculture, finance and international development from regional and international organizations.

The board members visited the facilities and the ongoing projects in the field and met with ICBA scientists to discuss the status of current and future projects. They were also given a snapshot of the impact ICBA's work has on the future of agriculture in marginal and saline lands. Day two included a closed session in which the board reviewed the financial statements of the center, the various achievements of 2014 in line with ICBA's 2013-2023 Strategy, and future plans.

ICBA's objective is to strengthen agricultural productivity in marginal and saline environments through identifying, testing and facilitating access to sustainable solutions for food, nutrition and income security.

In light of the growing world population and food demand, coupled with the adverse effects of climate change, the need for expertise in utilizing marginal lands for nutritional food production will increase. Scientists predict that the world is losing more than 1.5 million hectares of agricultural land each year as a result of high salinity levels in the soil. In the Middle East and North Africa and Central Asian countries, 6.7% of the total land area is affected by salinity.

During the past five years, ICBA carried several studies and strategies with the UAE Ministry of Environment and Water and the Environment Agency – Abu Dhabi covering subjects related to water conservation, water policies and laws, environmental guidelines, and sustainable agriculture.

Affecting policies is one side of the coin. The other is empowering the smallholder farms in marginal environments. Hence, ICBA is working on identifying the best crops, in terms of productivity and nutritional value, for various marginal regions as well as identifying the best farm management practices. Simultaneously, disseminate acquired knowledge to individual smallholder farms through various national farmers' services and unions.

ICBA's multi-pronged approach to address salinity issues and strengthen the agricultural sector through better access to technology, improved germplasm, policies, strategies and programs, is critical for achieving greater water, environment, food, nutrition, and income security. As more and more countries start struggling with agricultural land degradation and salinity issues, ICBA's ground breaking research will be vital in meeting future food demands.

ICBA Board of Directors meeting on 20 November 2014 at ICBA in Dubai

ABOUT ICBA

International Center for Biosaline Agriculture - ICBA is an international, non-profit agricultural research center established in 1999 that carriers research and development programs focused on improving agricultural productivity and sustainability in marginal and saline environments.

ICBA takes innovation as a core principle and the Center's multi pronged approach to address the closely linked challenges of water, environment, income, and food security include research innovations in the assessment of natural resources, climate change adaptation, crop productivity and diversification, aquaculture and bio-energy and policy analysis. The Center is working on a number of technology developments including the use of conventional and non-conventional water (such as saline, treated wastewater, industrial water, agricultural drainage, and seawater); water and land management technologies and remote sensing and modeling for climate change adaptation.

Improving the generation and dissemination of knowledge is an important strategic objective of ICBA and the Center is focusing on developing itself as a knowledge hub on sustainable management and use of marginal resources for agricultural production and environment protection in marginal and saline environments. With the help of its partners ICBA innovates, builds human capital, and encourages the learning that is fundamental for change.

ICBA's work reaches many countries around the world, including the Gulf Cooperation Council countries, the Middle East and North Africa, Central Asia and the Caucasus, South and South East Asia, and sub Saharan Africa.

Our work is mainly sponsored by three core donors: the Ministry of Water and Environment of the United Arab Emirates, the Environment Agency - Abu Dhabi, and the Islamic Development Bank. We gratefully acknowledge their support as well as the support of many other bilateral and multilateral agencies that have sponsored components of our work over the years.

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