كلية الآداب والعلوم
College of Arts and Sciences
QATAR UNIVERSITY جامعة قطر

















قسم الشؤون الدولية ومركز التنمية المستدامة

برنامج الفعالية وملخصات البحوث
المؤتمر الدولي:
النباتات الملحية والأمن الغذائي في الأراضي الجافة

Department of International Affairs and The Center for Sustainable Development

Event Program and Abstracts International Conference on Halophytes for Food Security in Dry Lands

Sponsor

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Day 1: May 12, 2014

8:00 - 8:30	Registration
8:30 - 9:30	Dr. Eiman Mustafawi Dean of the College of Arts and Sciences, Qatar University Dr. Muhammad Ajmal Khan Qatar Shell Professorial Chair for Sustainable Development, Qatar University (QU) Food and water security for Qatar: a new paradigm.
9:30 - 10:00	Coffee Break

Session I: Sustainable Halophyte Utilization

Moderators:	M. Clusner Godet, UNESCO, Paris and Hans –W. Koyro, Justus-Liebig-University of Giessen, Germany
10:00 - 10:30	John Cheeseman University of Illinois at Urbana-Champaign, Illinois, USA. Exploiting plants from extreme environments: world enough, but perhaps not time
10:30 - 11:00	David Masters University of Western Australia, Australia Genetic and environmental management of halophytes for improved livestock production
11:00 - 11:30	Kauser A. Malik Forman Christian College University, Pakistan A biological approach for economic utilization of salt Affected soils
11:30 - 12:00	Hasan El-Shaer Desert Research Center, Egypt Sustainable diversity of crops – livestock production system based on optimal utilization in Sinai: A case study.
12:00 - 12:30	Jed J. Brown Masdar Institute, UAE. Overcoming barriers to implementing high salinity agriculture in the Gulf
12:30 -13:30	Lunch Break

Session II: Sustainable Halophyte Utilization

Moderators :	Brent Nielsen, Brigham Young University, USA and Rainer Hedrich, Wuerzburg University, Germany
13:30 -14:00	Jorge Battle-Sales Universidad de Valencia, SPAIN. Multi-temporal soil salinity assessment at very detailed scale for discrimi nating halophytes distribution
14:00 - 14:30	Salma Daud I.A.V. Hassan II, Agadir, Morocco Traditional uses of some halophytes in arid areas of Morocco
14:30 - 15:00	Irfan Aziz Institute of Sustainable Halophyte Utilization, Pakistan Does foliar application of chemicals alleviates salinity effects in man groves?
15:00 - 15:30	Shahina Ghazanfar Royal Botanic Gardens Kew, UK. Restoration of coasts of the Gulf: use of halophytes, conservation and concerns
15:30 - 16:00	Coffee Break

Session III: Molecular Biology of Halophytes

Moderators :	Sergey Shabala, University of Tasmania, Australia and Samir Jaoua, DBES-CAS-QU
16:00 - 16:30	Brent Nielsen Brigham Young University, Utah, USA. Transcriptome and proteome analysis of genes involved in salt tolerance in the halophyte Suaeda fruticosa
16:30 - 17:00	Rainer Hedrich Biocenter, Wuerzburg University, Germany Nature and Molecular mechanism of sodium transport in plants
17:00 - 17:30	Muhammad Zaheer Ahmed Institute of Sustainable Halophyte Utilization, Pakistan Characterization and function of sodium exchanger genes In *Aeluropus lagopoides* under NaCl stress

Day 2: May 13, 2014

Session IV: Eco-physiology and Biochemistry of Halophytes

Moderators :	Jorge Battle-Sales, Universidad de Valencia, Spain and Kauser A. Malik, Forman Christian College University, Pakistan.
8:30 - 9:00	Hans –W. Koyro Justus-Liebig-University of Giessen, Germany. Eco-physiological investigations of potential fodder crop for arid regions
9:00 - 9:30	Sergy Shabala University of Tasmania, Australia. Learning from halophytes: physiological basis and strategies to improve abiotic stress tolerance in crops
9:30 - 10:00	Ismail Turkan Ege University, Izmir, Turkey. ROS regulation and antioxidant defense system in halophytes
10:00 - 10:30	Salman Gulzar Institute of Sustainable Halophyte Utilization, Pakistan Eco-physiological responses of halophytes along coastal Gradient
10:30 - 11:00	Coffee break

Session V: Biodiversity and distribution of halophytes

Moderators :	Hasan El-Shaer, Desert Research Center, Egypt and J. J. Brown, Masdar, UAE
11:00 - 11:30	M. Clusner-Godet Division of Ecological and Earth Sciences, UNESCO, France. The importance of mangrove ecosystems for nature protection and food productivity: Action of UNESCO's Man and the Biosphere Programme
11:30 - 12:00	Munir Ozturk Ege University, Izmir, Turkey Halophytic Plant Diversity of a Unique Habitat in Turkey – Tuzluca Salt Mine Cave
12:00 - 12:30	Mark Sutcliff UNESCO, Doha Office, 66 Lusail Street – West Bay, P O Box 3945, Doha, Qatar; (UNESCO) Floating Mangroves – a new concept for the production of seawater-based cash crop Halophytes – valuable economical and ecological Prospects for coastal dry desert and tropical countries
12:30 - 13:00	Lunch Break

Session VI: Biology of Halophytes

Moderators :	Shahina Ghazanfar, Royal Botanic Gardens, UK and Munir Ozturk, Ege University, Turkey
13:30 - 14:00	Abdul Hameed Institute of Sustainable Halophyte Utilization, Pakistan Exogenous chemical treatments to improve salt tolerance of cash crop halophytes
14:00 - 14:30	Karim bin Hamid Centre de Biotechnologie de Borj Cedria, Tunisia Cell suspension culture of the halophyte Cakile maritima: Establishment and response to salinity
14:30 - 15:00	A.K.M. Nazrul-Islam University of Dhaka, Bangladesh Plant community and germination of selected halophytes of Sundarbans mangrove forest and diversity
15:00 - 15:30	Coffee Break

Session VII: Concluding Session

Moderators :	Kauser Malik, Sergey Shabala, Hans Koyro, M. Clusner-Godet, Jed Brown, Ajmal Khan

Abstracts

Food and water security for Qatar: a new paradigm

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Human population has crossed the 7 billion barriers and requires massive amount of food. In order to meet this requirement, intensive agricultural practices have been causing destruction of arable areas of the world due to salinity, water logging, chemical pollution etc. The situation is more precarious in arid and semi- arid countries with low rainfall and high evapo-transpiration. Fresh water resources are either scarce or becoming limited and conventional irrigation practices, flood irrigation for instance without any consideration of leaching fraction are causing a steady increase in soil salinity in many areas. Although at present, salinity is mainly of regional significance and advances in agriculture have so far managed to feed the world but if this trend continues in the future will bring concomitant reduction in the yield of crops for human and animal consumption. Consequently it has become imperative to search for suitable alternatives and develop ecologically sustainable and economically sound biological systems that can use low quality water and drought-affected saline lands to produce plants of economic importance. A large number of halophytes could be used as animal forage or fodder without encroaching upon arable lands and irrigation water. This paper emphasizes the agricultural importance of these salt tolerant plants. Qatar is spread over an area of 11,571 square kilometers with hyper-arid climatic conditions but displays a higher biodiversity in local flora including halophytes. About 50% of the Qatari flora has potential economic usage such as animal feed. The coast of Qatar covers about 900 km and has halophyte with wide eco-physiological adaptations. This offers a unique opportunity to search for innovative new crops which could be grown using saline resources and thus reduce pressure on arable lands. There is a need to conduct a systematic survey of halophytic flora, ascertain the chemical characteristics of individual species for nutritive value, and subsequently identify those species suited to particular conditions and that are effective in animal feeding trials. The efforts being made would be shared.

Exploiting plants from extreme environments: world enough, but perhaps not time

John M Cheeseman
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The increases in global temperature in the last 4 decades, coupled with more severe droughts and more generally extreme weather variabilities are seriously challenging marginal, already stressed ecosystems. Plants in extreme environments are often already operating at their limits and despite their apparent tolerance of extremes, are highly vulnerable to land, water and climate degradation.

Nevertheless, in looking for agricultural solutions appropriate to feeding people in the new world, these “extremophiles” are a potential source of new crops (food, forage and fiber), particularly if their growth and reproductive performance can be adjusted to the needs of the human population. For this, additional knowledge and resources are needed. Thus, to understand the potential future effects of climate changes, with the goal of mitigating at least some of them, one approach is to develop new plant genetic models based on species already adapted to the more extreme conditions, to learn their “techniques” using comparative genomic and proteomic methods, and using breeding and evolution-

ary studies, to learn how to exploit their potential. The number of sequenced genomes, including those of halophytes, is rapidly increasing, thus enabling these approaches.

But the population of the world is rapidly increasing, particularly in the poorer and more environmentally challenged countries. Whether change can happen in time depends on many factors, including the will of governments and international organizations to seriously fund the efforts, the willingness of people, especially poor people and countries, to adopt new crops and methods, and the willingness of international agrobusiness to recognize the dire straights we are in and diversify from today's major cereal crops.

Genetic and environmental management of halophytes for improved livestock production

David Masters (ab) and Hayley Norman (b)
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Halophytic plants provide options for livestock feeding in both arid and saline landscapes. These plants are variable in both biomass production and nutritive value, they are characterised by slow growth, low digestibility (therefore low metabolisable energy) and high content of anti-nutritional factors. Poor feeding value has resulted from a natural selection process within native plant populations to survive herbivory and environmental stress. Hundreds or even thousands years of opportunistic and uncontrolled grazing has resulted in higher survival of unpalatable, low nutritive value plants with poor livestock production as an inevitable consequence. Recent research has focussed on genetic and environmental options to improve the feeding value (both through increased biomass production and improved nutritive value) of halophytes and early research provides the basis for optimism. Halophytes display wide genetic variation both within and across species in growth and nutritive value. Australian research has identified 50% variation in metabolisable energy content within Atriplex species, 2 fold differences in voluntary intake during the first 4 days of grazing and an 8 fold difference in edible dry matter production across provenances. Selection of provenances within this population provides opportunities to support both livestock growth and reproduction from halophytic plants. Environmental manipulation particularly through fertiliser selection has shown that different amounts and types of fertiliser not only change plant growth but also influence the content of anti-nutritional factors within the plants. Both changes in growth and palatability may therefore be influenced by fertiliser selection.

A biological approach for economic utilization of salt affected soils

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Forman Christian College (A Chartered University) Lahore

Salinity is becoming a major problem in arid and semi-arid regions of the world. Salinization of land is threatening the world food supply. Surface and ground water is rapidly becoming brackish and saline. Genetic improvement of crop plants for salt tolerance is the most feasible option. Plants have evolved different mechanisms and pathways for salinity tolerance. Halophytes which grow on the coastal areas and are able to use sea water offer a rich source of germplasm to search for new crops and useful genes. In addition, investigation of the microbial diversity and metagenomic analysis of the rhizosphere of halophytes can provide new information regarding osmoregulation and some of the genes thus identified could be used for developing salt tolerant economic crops.
Screening of the available germplasm for saltolerance has been carried out to select appropriate plants for different salt affected soils. The effect of the growth of these plants on soil chemical and

physical properties have been studied. The biomass thus obtained on such salt affected soils has been used for different purpose to make it economically sustainable. The details of such a biological approach will be discussed.

System based on optimal utilization of saline natural resources: A case study, Egypt

Hassan M. El Shaer
Desert Research Center, Mataria, Cairo, Egypt

1- Sinai Peninsula, based on the strategic, economic and social importance to Egypt, is considered one of the main development pillars at the national level. The ecosystem of Sinai is considered fragile where water resources are slightly poor (saline ground water or mixed water) in addition to low fertility soils with high level of salinity. The utilization of such fragile resources in growing salt tolerant fodder crops, cereals and oil plants may contribute to enhance the available natural resources and improve the standard of living of local inhabitants. The paper aimed at introducing and evaluating environmentally and economically feasible forage – livestock systems using brackish water in Sinai. In addition, assessing the impact of technology development and adoption on forage – livestock productivity systems. The studies were conducted at both research and smallholder farmers levels in two regions of Sinai: in South Sinai where groundwater (4000 to 10000 ppm TDS) is the main source for irrigation and soil is calcareous (calcium carbonate ranges from 30-80%). In North Sinai where mixed water from El Salam canal is used for irrigation and the soil is extremely saline with high water table.
The most important obtained results could be summarized in the following points:
Increased the degree of awareness among farmers for seed production technology of fodder crops and selection improved varieties and ensure genotypes purity. Adopting integrated management package for seed production (10 farmers). Adoption of the most salt tolerant genotypes for 3 forage crops (Pearl Millet, Sorghum and Alfalfa), 2 cereal crops (Triticale and Barley) and two oil crops (Safflower, Rap).In addition to Fodder beet - Panicum - Kokhia - Sudan Grass – Ray grass- Trifolium arborium and shrub forages of high nutritional and production values, e.g., Atriplex – Leucenia - Sesbania - Acacia –spineless Prosopis.

2- Active participation of farmers in development of improved management packages to improve irrigation water use efficiency and to raise productivity of forage and cereal crops and improve livestock production.

3- Improve the nutritive values and storage capacity of animal feeds through introducing new techniques (silage and feed blocks production) .

4- Economic evaluation of feeding animal on salt tolerant fodders at farmer›s levels showed an increase of about 60% in milk production and 80% in meat production; reduced feeding costs about 40%. Accordingly, 70%.increament of family income was achieved.
Key words: Brackish water, salinity, fodder crops, oil crops, animal production, farmer participation, Sinai, irrigation

Field and greenhouse trials of *Salicornia bigelovii* accessions

J. Jed Brown, Cylphine Bresdin, Edward P. Glenn
Masdar Institute of Science and Technology, UAE

An integrated seawater agriculture/aquaculture project is planned for the United Arab Emirates (UAE) that is slated to produce bioenergy from oilseeds (for aviation biofuel) and biomass from halophytes under seawater irrigation. In anticipation of this effort, experiments were undertaken to evaluate agronomically-important production traits (oilseed production, biomass production and harvest index) of a variety of wild populations of the annual halophyte, *Salicornia bigelovii*. We postulated that specific populations would perform better under the high temperatures and high salinity of the Gulf. Seed was collected from several populations from the U.S. states of Massachusetts, Virginia, Louisiana, Texas, Florida, the island of Puerto Rico, and from La Paz, Mexico. Plants were grown out for two generations in a controlled environment greenhouse in Tucson, Arizona, USA using moderately saline water, and for one year in outdoor field plots in Dubai, UAE using seawater and saline groundwater. To avoid problems associated with lack of seed production during the hottest summer months, seed in the outdoor plots was sown in the fall and harvested in the following early summer. Results from these efforts will be presented as well as some preliminary data on the production of halophytes native to the UAE under seawater irrigation. Data and seed from these experiments should help guide population selection and future breeding efforts for seawater agriculture projects in the Gulf Region.

Multitemporal soil salinity assesment at very detailed scale for discriminating halophytes distribution

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Halophytes differ widely in their tolerance to soil salinity, what is a restrictive condition for the growth of most plants. The salts accumulated in the soils control by dissolution, precipitation and cation exchange processes, the chemical composition of soil solution from where the plants extract the needed water and nutrients. The soil solution concentration and its composition depend highly of soil water content and change naturally in magnitude and type along the time, because of the variation of the meteorological conditions. Soil salinity can also present three-dimensional variability due to phenomena of evaporation on surface, salts leaching, lateral mouvement due micro-topography, slope of the polypedon and other factors.

The most used reference value for characterizing the level of soil salinity is the electrical conductivity of the extract of soil saturation paste (ECe). Most of the studies refer to certain threshold values of ECe for describing the plants tolerance to soil salinity in terms of growth and yield. The determination of ECe implies taken a soil sample. Repeated salinity assessment for a large area by soil sampling could be time consuming and expensive apart of disturbing the soil.

Actual soil salinity can most conveniently measured by geo-electrical survey (GES) or electromagnetic induction techniques (EMI). Apparent soil conductivity (ECa), that is close to the “real” condition of soil salinity, can be mapped quickly in three dimensions and measurements can be repeated at different times, making possible to produce high resolution 4-D maps of soil salinity in a Geographical Information System (GIS). The halophytes distribution can be mapped according to Braun Blanquet methodology and the correspondences between soil salinity levels and presence or absence of halophyte species can help to construct a conceptual model for the halophytes sinecology.

The Potential use of halophytes for the development of marginal dry areas in Morocco

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Agriculture is the principal lever of economic and social development in Morocco for whose GDP it contributes up to 19%. Morocco is a rural country since 45% of its population lives in the countryside. Nevertheless over 90 % of Morocco's area is semiarid, arid or Saharan. The rainfall in these regions is low, irregular and very unpredictable. The evaporation is very high especially in the continental parts exacerbating the water deficit and bringing about salinization even in places where it was not prevailing.

Because of the numerous environmental constraints, most of these areas have been neglected in the official development programs or have seen some attempts that failed because of the lack of adapted technologies to the local conditions and the socioeconomic context. And yet these areas which presented in the past an important bio-geographic diversity of natural resources are still inhabited by populations who are attached to their lands and to their traditions. Most of these people have also inherited an important local know-how from their parents who have managed to live in spite of the constraints since they have developed management techniques so-called "traditional" production systems that enabled them to optimize agricultural production under extremely adverse conditions. This paper presents some considerations for the identification and the evaluation of the capacity of these marginalised places to cope with climate change based on the capitalization of, the local know-how through its valorisation, the young human resources via appropriate training and the introduction of a biosaline agricultural approach with the proposition of solutions the restoration ofr biodiversity and productivity.

As a matter of fact, during the last 20 years the authors have worked on the sustainable utilisation of halophytic plants both in Morocco and in cooperation with other universities in European, African and Asian countries thus accumulating broad experience and developing expertise. These achievements need to be made available to farmers in marginal areas and should have regular monitoring and follow-up until the technology is fully integrated. The targeted areas are localised in two distinct locations: along the coast where the climate is relatively mild thanks to the moisture and in the continental oases that suffer from water depletion, local know-how progressive loss and labour impairment. With this approach, it is possible to motivate people and encourage them to use adapted techniques and technologies with the aim of growing productive crops which correctly marketed will contribute to the improvement of their income; their standard of living and hence the promotion of the economic development of marginalised areas.

Does foliar application of chemicals alleviate salinity effects in mangroves?

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Mangroves are distributed in the intertidal zones of tropical and sub-tropical regions and may survive in salinities higher than seawater. However, diversion of river water for irrigation has resulted in poor growth of mangroves and over exploitation has caused rapid decline in total mangrove cover. Recent studies have indicated vital role of antioxidants in improving salt tolerance through ROS (reactive oxygen species) scavenging in mangroves. Present study was designed to determine the effects of exogenously applied Ascorbic acid (AsA) and Glycinebetaine (GB) on growth responses of Avicennia marina and Rhizophora mucronata in saline conditions. Individuals were grown in control (nutrient solution; EC = 6 dS m^{-1}), moderate (50% seawater; EC = 26 dS m^{-1}) and hyper-saline conditions (150% seawater; EC = 85 dS m^{-1}). Seedlings were sprayed with chemicals and distilled water twice a week. Best growth in both test species was observed in 50% seawater and decreased in 150% seawater. Total dry weight and height of A. marina while only dry weight in R. mucronata was improved in AsA treated plants under saline conditions. Malondialdehyde (MDA) content decreased in AsA treated and increased in GB treated plants. Osmotic potential in both species increased with the increases in salinity in all treatments. An improvement in growth of mangroves with exogenous AsA treatment suggest beneficial effect of chemical rather than water in the solution and may be related to an efficient ROS scavenging. Our results indicate that exogenous spray of AsA could be used to promote growth of mangroves in saline conditions and may facilitate their rehabilitation.

Restoration of coasts of the Gulf: use of halophytes, conservation and concerns

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Coastal areas of the Gulf States of the Arabian Peninsula are over utilized for development and amenity. Several coastal areas are polluted or degraded to an extent where they are unsuitable for farming, building hotels or used as beaches. Such areas, to a large part, are considered useless or unattractive and left to degrade further. With good research and knowledge of shore dynamics and vegetation it is possible to restore these areas to a working and sustainable ecosystem. In order to restore coastal ecosystems it is imperative to know the native halophytic vegetation and their biology. Even though the process of restoration is slow, such projects are useful as they aim to run sustainably. Within a few years halophytic and other vegetation, and the associated fauna can be brought back. Use of halophytic communities for coastal restoration is important as well as their protection once restoration has been carried out. There are concerns that a lack of comprehensive knowledge of coastal vegetation of an area can lead to restoration with weedy and invasive species which will result in further damage to biodiversity and may not lead to a sustainable ecosystem.

Transcriptome and proteome analysis of genes involved in salt tolerance in the Halophyte *Suaeda fruticosa*

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4 Department of Computer Science, Brigham Young University, Provo, Utah

Suaeda fruticosa is a halophyte with potential for development as a cash crop, and has the ability to remove salt from saline soil. The seeds of this species are high in oil, which could be used as a cooking oil or for biodiesel. It has optimal growth at 300 mM NaCl. Little is known about the molecular basis for salt tolerance in this plant. Identification of the genes involved in salt tolerance and characterization of the expression of these genes and the corresponding proteins will help in gaining an understanding of the details of salt tolerance and the salinity response mechanism. Our work is focused on the identification of genes involved in salt tolerance through the de novo assembly of the transcriptome of Suaeda fruticosa. RNA was isolated from plants grown under no salt and optimal salt conditions. The RNA was used as template for cDNA synthesis, and the cDNA was sequenced using the Illumina platform. Characterization of the proteome by MudPIT analysis has been completed and correlated with the transcriptome. We have also analyzed differential expression of the transcriptome and proteome in plants grown with no salt compared to plants grown under optimal salt conditions. We will present details of the de novo transcriptome and proteome assembly and annotation of the genes and proteins from this species. We will also include results from the differential expression analyses and the identification of genes showing significant changes in expression levels in plants grown under optimal salt conditions.

Nature and molecular mechanism of sodium transport in plants

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Following our 1984 Patch Clamp-based discovery of potassium channels guard cells, ion channels were found in plant all plant cells looked at (Hedrich Phys Rev 2012). Besides the electrophysiological fingerprint, in the past 30 years the molecular nature of plant specific cation- and anion channel families were identified. What about plant sodium channel? We have started to study sodium transport choosing a gland cell system facing episodes of salt loads. Under high salinity as well as presence of stress hormone Na+ transport across the gland cell membrane increases. To search for genes encoding salt-induced Na+ transport proteins we established a gland cell-specific transcriptome. Therein we spotted a membrane protein that carried some molecular features of a bacterial-type potassium channel. Expressed in Xenopus oocytes the gland gene gave rise to an ion channel permeable Na+ only. Besides sodium-selective features of this channel we found associated an apparent very high Na+ transport capacity and a voltage-dependent Km value. Thus by changing the membrane potential glands cell can adept their Na+ transport affinity to fluctuating salt loads.
We are currently exploring the biology of gland cell-type sodium channel in two halophytes: quinoa (Chenopodium quinoa) and saltbush (Atriplex halimus). The species superior ability to grow and produce yield on highly saline soils is achieved by its ability to sequester excessive salt in the specialised unique trichome-like external structures called salt bladders. At the meeting current data will be presented as to which degree e.g. polymorphisms in their Na+ channels and/or regulation network might allow some C. quinoa and Atriplex ecotypes and cultivars to remove efficiently salt from the growing plant body into salt bladders.

Characterization and function of sodium exchanger genes in *Aeluropus lagopoides* under NaCl stress

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The salinity tolerance in halophytes is reported to be a function of sodium ion regulation. Present study was designed to understand the role of SOS1 and vacuolar-Na^+/H^+ antiporter genes in Na^+ regulation when *Aeluropus lagopoides* plantlets were grown in NaCl solutions. An expressed sequence tag of SOS1 and full length cDNA of vacuolar-Na^+/H^+ antiporter (AlaNHX) gene were isolated by RT-PCR. Plantlets of A. lagopoides were grown at different NaCl concentrations (0, 150, 300 and 600 mM) for 15 d and its growth, membrane leakage, ion compartmentalization, and expression of selected genes was studied. Full-length cDNA of vacuolar-Na^+/H^+ antiporter (GU199336; AlaNHX) consisted of 2353 bp including 337 and 393 bp of un-translated regions (UTR) at 5' and 3' end, respectively. In addition, AlaNHX have an "open reading frame" (ORF) of 1623 bp which translated into AlaNHX protein of 525 amino acids. Expressed sequence tag (GW796824; ISHU-Ala-4) of SOS1 used for gene expression consisted of 204 bp. Growth was optimized in non-saline control. MDA content began to increase from 300 mmol L^{-1} NaCl and increased to much higher level in 600 mmol L^{-1}. Na^+ was accumulated in the vacuoles of root and leaf tissues indicating an up-regulated expression of AlaNHX. The rate of Na^+ secretion increased with concomitant increase in up to 300 mmol L^{-1} NaCl. The expression of SOS1 in root tissue positively correlated with Na+ in leaves (0.943; $P < 0.01$) as well as Na^+ secretion rate (0.771; $P < 0.05$). There was no change in the expression of both genes at 300 and 600 mmol L^{-1} NaCl except for SOS1 in root tissue. The finding reported above indicate that both sodium exchanger genes contributed in reducing the Na^+ ion toxicity in cytoplasm at NaCl concentrations lower than 300 mM NaCl.

Ecophysiology of halophytes: the dilemma between tolerance, avoidance and escape

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The natural salt-affected areas are characterized by a unique flora of halophytes, with an unusual ability to cope with salinity, far above that of most domesticated plants. However, saline habitats and their flora are now threatened by global warming, by rising sea-levels, the intensification of storms and consequent erosion. The increase in the number of years with extreme weather conditions has also contributed to a rise of agricultural areas affected by salt and to the replacement of parts of the current vegetation by halophytic plants. The formation of new «salt deserts» with strongly degraded vegetation can lead to the formation of storms of salt dust, similar to those that now occur in central Asia, which affect the surrounding environment, influence human health, and drastically damage economic assets.

Halophytes have a major role to play in environmental protection of such habitats. They represent about 1% of the world's flora and are morphologically and physiologically adapted to the extreme conditions of saline habitats. Halophytes not only survive under saline conditions but flourish, many species making their optimal growth when supplied with brackish water. Halophytes occupy niches from the marine to the arid, from salt deserts to salt marshes and this range of habitats is reflected in a variety of recognized 'physiotypes'.

They show a variety of adjustment in response to hyperosmotic salinity ranging from escape via avoidance through to tolerance. Often survival at salinity relies on controlled uptake and compartmentation of the mineral ions dominating the environment, and on the synthesis of organic 'compatible' solutes that aid osmotic adjustment within the cytosol, little is known of the transporters and regulatory networks involved.

However the information on halophytes is often incoherent. There is a necessity to deliver evaluations of the ecological bases for the conservation of halophytes, their uses in protection of vulnerable sites, the restoration of salt-affected land and support the timely development of a saline agriculture using brackish water as a replacement for depleting sources of freshwater. The aim is to generate recommendations for future research including into the salt resistance of plants at the molecular, plant and ecosystem levels. Considerable further collation of existing data will reveal the potential of halophytes in agriculture.

Learning from halophytes: physiological basis and strategies to improve abiotic stress tolerance in crops

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Global annual losses in agricultural production from salt-affected land are in excess of US$12 billion and rising. At the same time, a significant amount of arable land is becoming lost to urban sprawl, forcing agricultural production into marginal areas. Consequently, there is a need for a major breakthrough in crop breeding for salinity tolerance. Given the limited range of genetic diversity in this trait within traditional crops, stress tolerance genes and mechanisms must be identified in extremophiles and then introduced into traditional crops. In this review work I argue that learning from halophytes may be a promising way of achieving this goal. Two central questions are considered: what are the key physiological mechanisms conferring salinity tolerance in halophytes that can be introduced into non-halophyte crop species to improve their performance under saline conditions? and what specific genes need to be targeted to achieve this goal? The specific traits that are discussed and advocated include: manipulation of trichome shape, size and density to enable their use for external Na+ sequestration; increasing the efficiency of internal Na+ sequestration in vacuoles by the orchestrated regulation of tonoplast NHX exchangers and slow and fast vacuolar channels, combined with greater cytosolic K+ retention; controlling stomata aperture and optimising water use efficiency by reducing stomata density; and efficient control of xylem ion loading, enabling rapid shoot osmotic adjustment while preventing prolonged Na+ transport to the shoot.

Reactive oxygen species regulation and antioxidant defence in halophytes

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Reactive oxygen species are produced during metabolic activities as a by-product and halophytes are no exception to this rule. Different stress conditions can induce accumulation of ROS, including salinity, by uncoupling the production and scavenging of these molecules. ROS can be toxic when accumulated over a certain threshold and can cause oxidative damage to lipids, proteins, and DNA and can also alter the redox state of the cell due to excessive oxidation. Besides their toxic role during oxidative stress, ROS can also act as important signal molecules for control of the growth, development and stress responses. Plants use an array of enzymatic and non-enzymatic antioxidants to control the cellular and organellar levels of ROS. Although role of enzymatic and non-enzymatic defence mechanisms can be related, little information is reported on ROS-mediated signalling, perception and specificity in different halophytes. Hence, in this review, we first present the recent advances in ROS homeostasis and signalling in response to salt, and then discuss the current understanding of ROS involvement in stress sensing, stress signalling and regulation of acclimation responses in halophytes. We also highlight the role of genetic, proteomic and metabolic approaches for the successful study of the complex relationship among antioxidants and their functions in halophytes, which would be critical in increasing salt tolerance in crop plants.

Ecophysiological responses of halophytes along coastal gradient

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Coastal halophytes are highly resilient against large temporal and spatial variations in environmental conditions such as moisture, salinity, and temperature. Some of these plants are grazed by cattle besides being excellent sand binders. Seasonal variations in leaf level physiology of dominant coastal plants could provide insight into their optimal growth conditions and could help in restoration efforts. The present study investigates the photosynthesis, ionic and anti-oxidant responses of three C4 plants; Halopyrum mucronatum, Suaeda fruticosa, Sporobolus tremulus and the C3 mangrove Avicennia marina. Lowest soil pH and electrical conductivity (ECe) and high organic matter content were observed in winter. However, the lowest rates of photosynthesis, transpiration rates and water use efficiency were observed in the test species during this season. This coincided with increased leaf thickness, high Na+ content, proline, total soluble sugars and antioxidant enzyme activities. Suaeda fruticosa appeared to buffer environmental stresses by maintaining higher water use efficiency and leaf succulence, lower chlorophyll content and hence lesser requirement of antioxidant defense system (low proline content, CAT and SOD activity). Our data indicates that lower winter temperatures appear to be more stressful for growth of C4 species. We have also discussed the implications of our results to understand the patchy distribution of vegetation along the coast.

The importance of mangrove ecosystems for nature protection and food productivity: Action of UNESCO's Man and the Biosphere Program.

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Although mangrove ecosystems are globally rare and cover only around 152,000 km², these systems have a very high economical and ecological value by offering a large range of ecosystems goods and services. Desert and semi-desert countries in have a high potential for the development of mangrove ecosystems. The whole Middle East region has some of the most arid coastlines in the world. Only very few rivers reach the sea and mangroves are limited to lagoons and tidal creeks. However, mangroves have a high ecological value, as in some areas they are the only trees that occur. They offer unique opportunities for foraging for livestock and nesting place for birds. Moreover, mangroves ecosystems are the nursery for many pelagic organisms, which are at the beginning of the food chain in coastal waters. Many crab and fish species have their origin in these areas. Mangroves are as well used as a feeding ground for goats and camels and for fire wood. Fishing, collection of shells and other uses are frequently reported. They are also in some areas nesting grounds for sea turtles and other large animals. Mangroves have also very important scenic and aesthetic functions and are widely used for recreational purposes, such as nature tourism and recreational boating. They offer a good protection for possible tsunami impacts.

It is in this contact that UNESCO's Man and the Biosphere Programme (UNESCO/MAB) produced in cooperation with the World Timber Trade Organization (ITTO), the International Society for Mangrove Ecosystems (ISME), the United Nations Food and Agricultural Organization (FAO), the United Nations Environmental Programme and its World Conservation Monitoring Centre (UNEP/WCMC), the United Nations University International Network for Water, Environment and Health (UNU/INWEH) and The Nature Conservancy (TNS) the World Atlas of Mangroves in three languages, English, French and Spanish. This Atlas provides a world-wide overview of the distribution of mangroves ecosystems. In fact, mangroves are found in 123 countries and cover a total area of 152,000 square kilometres. A total number of 73 species is given as well as total above-ground biomass of over 3700 Tg of carbon with a sequestration rate for carbon in the range of 14-17 Tg per year (Source World Mangrove Atlas 2010).

As there is a growing need in the world to enhance food and non-food-production for human use, mangroves play an important role in this context. Wood products including fuel wood, tannins, roofing products are key products. Many mangrove species produce fruits and honey for food and many leaves can be used for herbal teas. But hunting and gathering of animals are certainly the most widespread food products from mangroves Very important products are also medicinal products and tannins. Finally it is worthwhile to mention the very important role of mangroves in biofiltration, which enable mangroves to remove excess nutrients and other pollutants from the soil.

However, mangroves are under constant threat due to land-use for agricultural purposes, overexploitation for aquaculture, overfishing and overharvesting. Pollution, sedimentation and alteration of flow regimes are direct threats with sometimes dramatic consequences. Therefore, urgent action is needed to establish sustainable management schemes for mangrove ecosystems all over the world, including in dry Arab lands. Restoration, afforestation and flow restoration are crucial for their survival. Mangroves figure among the most productive ecosystems in the world and provide a large array of plant and animal products for human beings.

In order to tackle these issues better and to alarm the large public and the respective decision-makers, UNESCO/MAB and its partners have produced in 2012 the policy brief on “Securing the Future of Mangroves”.

Halophytic plant diversity of a unique habitat in Turkey-Tuzluca salt mine cave

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Salt mines are among the safest of mines. While mine temperature varies with depth, the average temperature remains about 70 degrees year-round. Salt may appear in veins like coal. Veins are the original bedded salt deposits. Salt may also be found in domes. Salt domes are formed when earth pressures force salt up through cracks from depths as great as 9 or 12 km.
The rock salt deposits in Turkey have appeared during triassic in closed lake calyces. There are more than 30 rock salt deposits in the country starting from the Province of Çankırı in Central Anatolia and continuing through Yozgat, Sivas, Erzincan, Erzurum, Kağızman and Tuzluca to Iran. The reason for these large salt deposits is the geological structure of Turkey. The deposits are found in Sekili(Yozgat), Çankırı, Gülşehir (Nevşehir),Tepesidelik (Kırşehir), Tuzluca (Iğdır), Kağızman (Kars) and Oltu (Erzurum).

Tuzluca rock salt deposits are found in the small town of Tuzluca formerly known as Koghb, Kulp, and Goghb with an area of 1236 km2 lying at an altitude of 1075 m (asl). The name Tuzluca means salt in Turkish and this is the reason why the town has been renamed. It lies within the borders of Iğdır Province in the East Anatolian geographical division of Turkey. The town is surrounded by Aras river in the North; which forms a border between Turkey and Armenia; Taşlıçay town from the State of Ağrı in the South, Iğdır city center in the East, and Kağızman town of Kars State in the West. The study area “Tuzluca Cave” is situated in the town of Tuzluca. The town is only 2 km away from the border from the border twon of .Armenia. The rock salt deposits present here are operated by TEKEL Salt Management. The distances from Iğdır, Kars, Erzurum, Ankara and Istanbul are 39 km, 90 km, 250 km, 1000 km, 1600 km respectively.
The climate is mild continental type within the hrash climatic features in the area. The annual precipitation is 326,2 mm and it is one of the driest areas in Turkey. The temperatures inside the salt mine are around 12˚C, and humidity around varies between 41-42 percent.

2007-2011
The studies in this area were undertaken during 2007-2011. The plants collected during this period were identified with the help of 11 volumes of “Flora of Turkey and The East Aegen Islands” The area lies within the Irano-Turanian phytogeographical region. The plant taxa dominating the study area include taxa like; Halanthium rarifolium, Anabasis aphylla, Atriplex lehmanniana, Atriplex tatarica, Halothamnus glaucus, Kalidium caspicum, Salsola verrucosa, Salsola dendroides, Suaeda microphylla, Halogeton glomeratus, Noaea mucronata, Seidlitzia florida, Bienertia cycloptera, Cam-

phorosoma monspeliaca, Ceratocarpus arenarius, Kraschneinnikovia ceratoides from Amaranthaceae; Reaumaria alternifolia from Tamaricaceae; Artemisia santonicum from Asteraceae, and Atraphaxis spinosa from Polygonaceae.

Out of these Halanthium rarifolium is used at a large scale by the locals in the area for clean washing of clothes. The aboveground parts of the plant are ground and placed inside the laundry which makes the clothes more clean and brighter and soft. Salsola dendroides is used as fuel wood in the area during cold winters.

Floating mangrove project: A sustainable approach for combating climate Change

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Members of the international scientific and biodiversity conservation community know about the immeasurable service-value that mangrove ecosystems provide for ecosystem functioning. Many attempts are ongoing to better conserve mangroves in coastal zones, where the majority of them are naturally occurring. Globally mangroves are seriously and rapidly declining in area coverage. The coastal zones are narrow in width, and; therefore, offer rather limited space for mangroves, which naturally depend in tidal fluctuations. Some experts, supported by decision makers, have succeeded to increase localized mangrove coverage, for example in Abu Dhabi, and in Eritrea. Others have suggested producing mangroves in inland deserts under seawater irrigation to make the deserts green. This is a controversial approach, because of the dangers of irreversible salinization of soils and ground-water, as well as habitat loss. This proposal offers an innovative idea that has not yet grasped the attention of the climate change movement: Floating Mangroves for carbon sequestration. If it works it might be a real blessing to influence atmospheric carbon levels in the best interest of mankind. Moreover, floating mangroves can also reduce land-based marine pollution by intake of potassium, nitrogen, and phosphates, which will possibly reduce harmful-algal-blooms.

Exogenous chemical treatments to improve salt tolerance of cash crop halophytes

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Cultivation of halophytes on barren saline lands for food/fodder, fuel and other economic uses is widely recognized as an environmental friendly way to support burgeoning human population in future. Despite natural salt tolerance, high salinity causes reduction in both germination and growth of halophytes. We examined the feasibility of exogenous application of different chemicals for improving salt tolerance of *Suaeda fruticosa, Limonium stocksii and Atriplex stocksii*. Seed germination of all test species decreased with increases in NaCl concentration. Exogenous chemical treatments differentially improved germination inhibition which also varied with species. Growth of all species inhibited at 600 mM NaCl. Exogenous glycine-betaine and ascorbic acid improved growth of *S. fruticosa* and L. stocksii by improving membrane damage. Our data indicates that chemicals may have differential and species specific responses in improving germination and growth of halophytes under saline conditions.

Halophytes as model plants to investigate mechanism of salt tolerance

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Worldwide, salt stress is one of the main environmental constraints that decrease plant growth and crop productivity. Every minute, three hectares are lost for agriculture due to inappropriate irrigation practices. Salt stress affects cellular homeostasis as well as osmotic homeostasis. Most crop plants are very sensitive to the presence of sodium in the soil. Interestingly some plants called halophytes have developed original adaptation to cope with the presence of salt. In the last decades, considerable progress has been made in the understanding of plant physiology and development through the development of the Arabidopsis model plant. Several halophytic species like Mesembryanthemum crystallinum, Thellungiella salsuginea ex. halophila, Spartina alterniflora have been proposed as model plants to investigate salt tolerance mechanisms. The aims of this paper are to present the advantages and limits of some proposed model plants, to try to define what a halophyte model species should be and to discuss the possibility to propose the halophyte Cakile maritima as new Brassicaceae model to dissect salinity tolerance.

Plant community and germination of selected halophytes of sundarbans mangrove forest and diversity

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Plant community types of halophytes of different ecological zones from Sundarban mangrove forests were identified and the changes were discussed. Dominant plant species of the ecological zones and the nature of adaptation were evaluated. Formation of consociation in the Polyhaline zone and also to a lesser extent in Mesohaline zone of the halophytes was observed. In contrast, the Oligohaline zone exhibited mixed plant community. Seasonal variations of soil chemical conditions particularly salinity and water chemistry were highly variable. It was noted that exchangeable calcium is the dominant cation followed by magnesium. Salinity (conductivity) in the river water from selected locations showed strong seasonal variation and was several times higher in the Ologohaline zone at the end of the winter season (March) than in the monsoon season. This is due to the unavailability of fresh water supply from upstream through the river Ganges. Germination behavior of Heritiera fomes and Xylocarpus granatum in relation to salinity were investigated to explain the nature of adaptation. Seedlings of Sonneratia apetala planted (monoculture) in the Oligohaline zone in the experimental plot showed vigorous growth within three years. Plant species from the quadrats of circular plots of 2m radius were recorded and Diversity was measured by H´, the Shannon-Wiener Index. Ecological diversity was measured based on rarefaction of the actual samples,

$$E(S)=\sum\{\ 1-[\ (N-_{n}Ni)/(\ \underset{n}{N}\ )]\ \}$$

The diversity values showed correlation with the ecological conditions. The rarefaction methodology was compared with a number of diversity indices using identical data and was found to be influenced by sample size. The abundance of species ranked from most to least abundant (in geometric series) was also calculated as

ni = NCKK (1 – K)i-1

The data were also analysed with the log series and the Q statistic to bring plant diversity of the halophyte to a sharper focus. The result indicated a strong diversity of the halophytes of Sundarbans mangrove forest. Plant succession pattern and the plant composition in Oligohaline and Mesohaline zones were evaluated.

Economic sustainability for halophyte cash farms in urban environments

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To successfully establish halophyte cash farm requires an economic model that is embedded in the goals, development structure, implementation, management and budget from the onset. Goals must identify clearly if the project intends to be research-focused or if it is to be 'sustainably profitable', or if both, how is this accomplished. This decision sets the course for its long term viability as a cash-productive model for others to replicate. Too often, great concepts and projects fail to withstand the commercial test of time by failing to establish economic sustainability into their plans. They become victim to subsidization, grants, and capital debt which results in an addiction common to research-focused projects.
This presentation will attempt to provide guidelines on how to build economic sustainability into a halophyte cash farm project in order to demonstrate its economic value to a community and thus ensure longevity in its mission. It will provide meaningful economic value, create jobs, and enhance community sustainability by reducing carbon footprint, increasing local food or product inventories, and introducing local, regional, and global edu-tourism.

Toward development of halophytic groundcover species for warm region urban landscapes

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Freshwater shortages are occurring worldwide as demand escalates, resulting in increased use of secondary, saline waters for irrigation of urban landscapes. Climate change with associated saltwater intrusion is driving the salinization of coastal soils and aquifers, where most major world cities lie. Though studies have been limited, information regarding the salinity tolerance of potential groundcover species is required prior to their successful use in saltwater irrigated urban landscapes. Salinity tolerance adaptations of 17 groundcover type species adapted to warm arid climatic regions was investigated in a controlled environment greenhouse. Relative shoot dry weight, root dry weight, and % green leaf canopy were highly correlated under salinity stress, indicating their mutual effectiveness in indicating salinity tolerance. Malephora lutea, Phyla nodiflora, Acacia redolens, and Baccharis sarothroides x B. pilularis suffered no visual injury, indicated as 100% GC, up to 9000 mg•L-1 salinity. These species also displayed stimulated shoot and root growth, relative to control, under moderate to high salinity, indicating their halophytic nature. Lantana camara x L. montevidensis was moderately salt tolerant, maintaining 100% GC up to 6000 mg•L-1 salinity, with associated shoot growth stimulation up to that salinity. Relative salinity tolerance progressively declined in the remaining species, with GC ranging from 75 to 0% at 9000 mg•L-1 salinity. The most salt sensitive species were Glandularia tenera and Oenothera stubbei, suffering complete shoot death (0% GC) at 3000 mg•L-1 salinity. Salinity tolerance indicators GC, SW, and RW were positively correlated with shoot K+ and K/Na ratios, and negatively correlated with shoot Na+, indicating the importance of shoot ion selectivity to salinity tolerance in all species except Malephora lutea. Malephora lutea is unique among species studied, being a Na+ accumulating succulent halophyte.

Importance of the SOS system on halophytism and the control of flowering time

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Despite substantial efflux of Na^+ across the plasma membrane of root cells, the net flux of Na^+ is unidirectional from soil to roots and then to the shoot. Compared to glycophytes, halophytes appear to have an exceptional control over Na^+ influx combined with efficient export mechanisms, the ability to coordinate Na^+ distribution to various tissues, and the efficient sequestration of Na^+ into vacuoles. The SOS (for Salt Overly Sensitive) pathway is emerging as an ubiquitous system in plants controlling both the net rate of Na^+ uptake by roots and, together with HKT proteins, the translocation to shoots via the xylem. SOS1 is a plasma membrane Na^+/H^+ antiporter involved in removing Na^+ ions from cells. The contribution of SOS1 to salinity tolerance in halophytes was analyzed in RNA interference (RNAi) lines of the Arabidopsis thaliana relative Thellungiella salsuginea that normally can grow in seawater-strength salt solutions. Thellungiella SOS1-RNAi lines showed a strong salt-sensitivity phenotype, faster Na^+ accumulation, more severe water loss under salt stress, and slower removal of Na+ from the root after removal of stress compared with the wild type. After prolonged salt stress, Na+ accumulated inside the pericycle in SOS1-RNAi lines, while Na^+ was confined in vacuoles of epidermis and cortex cells in the wild type. The protein kinase SOS2, a positive regulator of SOS1 transport activity, has recently been shown to interact with and to control the stability of GIGANTEA (GI), a major flowering time regulator in Arabidopsis. Adaptation to salt stress is mechanistically based on SOS2 release and GI degradation under saline conditions, thus retarding flowering. The GI–SOS2 interaction explains in molecular terms, the long observed connection between floral transition and adaptive environmental stress tolerance, a link that will be critical for the successful use of halophytes for food security in dry lands.

Presentation

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A subset of cellular proteins, called non-cell-autonomous (NCA) proteins, can function in some types of cells beyond their expression zone. Recent reports have shown different kinds of molecules (auxin, RNA and proteins – transcription factors) playing a vital role in plant development by NCA control of cell fate determination and cellular differentiation. However, the evolutionary relationship between cell-autonomous and NCA transcription factors (TFs) remains elusive.

We isolated INTERCELLULAR TRAFFICKING Dof1 (ITD1) (At4g00940 – AtDof4.1) as a NCA-TF in a genome-wide screen using the GAL4-UAS activation system in Arabidopsis. The plant specific Dof (DNA binding with one finger) TFs family has both the cell-autonomous and NCA TFs. AtDof4.1, named INTERCELLULAR TRAFFICKING DOF 1 (ITD1), was chosen as a representative NCA member to explore this evolutionary relationship. We observed trafficking of ITD1-mCherry fusion from cortex / endodermis to the neighboring cells in contrast to AtDof5.4-mCherry which remains confined to the expression zone, as compared to the cell-autonomous control Myb88-mCherry fusion protein. Similarly the selective trafficking behaviour was established when ITD1 conferred gain-of-trafficking function on cell-autonomous proteins, GL1 and H2B.

Using domain structure–function analyses and swapping studies, we examined the cell-to-cell trafficking of plant specific Dof TFs across the family from Arabidopsis and other species. By deletion analysis we identified a conserved 50 amino acids long intercellular trafficking motif (ITM) that is necessary and sufficient for selective cell-to-cell trafficking and can impart gain-of-function cell-to-cell movement capacity to an otherwise cell-autonomous TF. The functionality of related motifs from Dof members across the plant kingdom extended, surprisingly, to a unicellular alga that lacked plasmodesmata. Multiple sequence alignment identified an N-variable region and conserved zinc coordination motif. Domain swap analysis revealed that the N-variable region is necessary but not sufficient for trafficking.

By contrast, the algal homeodomain related to the NCA KNOX homeodomain was either inefficient or unable to impart such cell-to-cell movement function. The Dof ITM appears to predate the evolution of selective plasmodesmal trafficking in the plant kingdom, which may well have acted as a molecular template for the evolution of Dof proteins as NCA TFs. However, the ability to efficiently traffic for KNOX homeodomain (HD) proteins may have been acquired during the evolution of early nonvascular plants.

Functional study was performed to establish the developmental role of ITD1. We could not detect any obvious visual phenotype for the ITD1 knock-out lines, probably due to the high level of redundancy in members of Arabidopsis Dof family; however, the over-expression lines showed severe growth retardation and delayed bolt extension. Similarly over-expression of ITD1 fusion with super repressor domain (SRD) showed severely delayed flowering and defective reproductive organs development. Generally all the organs of ITD1-SRD over-expression were small in size. Siliques of ITD1-SRD over-expression lines were short and curled. Due to similar morphology of over-expression ITD1 and ITD1-SRD we guess ITD1 might be an endogenous repressor. Transcriptional fusion with GUS and GFPer reporters was carried out to determine the spatio-temporal expression of ITD1.

Biographies

Muhammad Ajmal Khan

Dr. Muhammad Ajmal Khan, Qatar Shell Professorial Chair of Sustainable Development and Professor, Department of International Affairs, in the College of Arts and Sciences has spent about 34 years in teaching and research. He was awarded the degree of M. Sc. by the University of Karachi, Ph.D. by Ohio University, USA and D. Sc. by University of Karachi. He is the recipient of postdoctoral fellowship at Brigham Young University, USA, DAAD; Fulbright visiting scholar and Adjunct Professorship in the Brigham Young University in 1996. Presidential award of the "Pride of Performance" on 14th August, 2001 and Sitara-i-Imtiaz in 2007 were awarded in recognition of his scientific contribution for Pakistan. Pakistan Academy of Sciences elected Dr. Khan its fellow in 2001 while Academy of Science for Developing World (TWAS) in 2004 and Islamic Academy of Sciences (IAS) in 2011. Higher Education Commission, Pakistan, accorded him the title of "Distinguished National Professor" during 2005. He is holder of the UNESCO chair for Sustainable Utilization of Halophytes. Dr. Khan research includes seed germination and salinity tolerance of halophytes with the development and screening of non-conventional cash crop for saline arid regions. Prof. Khan has completed 30 research projects has also published more than 225 research papers, edited 10 books. Professor Khan has been a Founder & Director, Institute of Sustainable Halophyte Utilization, University of Karachi, Pakistan which was created to provide state of the art facilities for research on developing non-conventional crops for saline areas.

John Cheeseman

John Cheeseman is a Professor emeritus in the Department of Plant Biology at the University of Illinois. Throughout his career, he has focused his research and publications on the organismal biology of halophytes, from the molecular and physiological levels to the ecological. His primary concern has been the mechanisms by which these plants integrate their activities to allow them to function and thrive in what is usually considered a harsh or extreme environment. Because the problems and associated mechanisms extend well beyond the level of a few transporters or genes or individual processes such as photosynthesis, Prof. Cheeseman has developed a personal knowledge-base with applicability to both basic and applied aspects of halophyte biology.

David Masters

Dr Masters worked as a senior scientist and research leader with CSIRO (Australia's national scientific and industrial research organisation) and the University of Western Australia for 25 years. He has an international research reputation in livestock production in saline areas, mineral, amino acid and protein nutrition, wool production and livestock systems. This research experience has resulted in over 200 journal, conference and technical articles and presentations of more than 100 industry and scientific seminars and workshops across Australia and overseas. As a national research manager for CSIRO and the Salinity Cooperative Research Centre he implemented research programs to address industry problems through the application of good science. Dr Masters has experience in the training and supervision of young scientists and postgraduate students and is formally trained in research management, economics, financial evaluation, risk analysis and conflict resolution in addition to agriculture. In 2006 he was elected a Fellow of the Australian Society of Animal Production for services to livestock industries in Australia. Since leaving CSIRO, Dr Masters has continued to operate as a Livestock Systems Scientist and also Chairs a number of national research committees; he remains an Honorary Research Fellow with CSIRO and an Adjunct Professor at the University of Western Australia

Kauser A. Malik

Dr. Malik has been involved in agricultural research focusing on biological approaches for economically utilizing salt affected wastelands through plant microbial interactions and biotechnology. In the past several competitive research grants were awarded to him which resulted in the development of Biosaline Agriculture Technology. This technology was later propagated through a national developmental project (NABSAP). In addition this technology was also shared with various countries of the region under the sponsorship of IAEA during my tenure as Member (Biosciences) of PAEC . Later on during my tenure as Member (Food & Agiculture) of the Planning Commission I was involved in developing a mega projects on Biosaline Agriculture to cover all major salt affected areas of the country. Dr Malik has more than 250 research publications in peer reviewed journals and has supervised 20 PhD students and several MPhil students. He has co-authored nearly 5 patents and has authored/edited 7 books

Hassan M. El Shaer

Dr. Hassan El Shaer Egyptian and born on 20 October 1949. The Present position is Professor of Animal Nutrition & Rangelands Utilization, the Ex –Vice President, Desert Research Center(DRC).He have been working at DRC, Cairo, Egypt over 40 years. Dr. El Shaer have broad experiences in planning, preparing, conducting and reporting research and development studies and projects related to livestock production, halophytes and salt tolerant forages management and utilization, rangelands utilization, combating desertification , cooping with climate changes ,rural family empowerment and development and enhancing capacity building. He is expert in utilization of organic wastes (i.e. agro- industrial by – products; field crops residues; vegetable and fruit market wastes, and other organic wastes) for compost, mulch materials , animal feed, mushroom , biogas , etc. as well as utilization of halophytes and salt tolerant plants as animal feeds. He has lots of experiences in organizing and preparing comprehensive training programs, field days, workshops, conferences and other scientific events at national, regional and international levels in addition to coordinating research - extension , training and awareness activities for enhancing capacity building.

Dr. El Shaer had many international scientific awards and scholarships such as :Post-doctoral research for 2 years at the Animal and Biochemistry Dept., Univ. College of North Wales, Bangor, U.K.;Post-doctoral research for 6 months at the Dept. of Veterinary Physiology, Pharmacology and Toxicology, School of Veterinary Medicine, Louisiana State University, U.S.A,; and Post-doctoral research for 16 months at the American Institute for Goat Research, Langston Univ., OK, U.S.A.Dr. El Shaer has been acting as the Principal Investigator of 11 national Financed Projects by Egypt Government and 10 international Financed Projects (from USAID, EU, ACSAD, EC (DG.I)-CIHEAM , ICBA - Dubai, OPEC- ICBA- DRC, IFAD, AFESD, IDB, OFID , European Neighborhood Policy and Financing Instrument (ENPI), AIGR-USDA

Jed J. Brown

Dr. Brown received his M.S. from Stony Brook University, USA and his Ph.D. from the University of Arizona, USA. He has experience cultivating halophytes and using halophytes to treat saline aquaculture effluent and has published articles in these areas, as well as in the physiology of halophytes. He joined the Masdar Institute of Science and Technology in Abu Dhabi, UAE in 2011 to help support the development of the Integrated Seawater Energy and Agriculture System (ISEAS) project, an integrated seawater agriculture/aquaculture project aimed at developing biofuels for the aviation industry. He has worked in U.S. natural resource agencies for over thirteen years. Prior to coming to Masdar, he was Chief of Fisheries and Assistant Director of the Division of Fish and Wildlife of the Government of the U.S. Virgin Islands.

Jorge Batlle-Sales

Jorge Batlle-Sales was born in Murcia (Spain). He studied at the Universidad Autonoma de Madrid, and his background is on Geochemistry (Graduation 1969-1974) and on Soil Genesis&Chemistry (Doctorate 1979). He is Chair Professor of the University of Valencia (Spain), teaching Pedology, Soil Chemistry, Hydrogeology, Environmental Cartography, and Management and Conservation of Natural Resources, at Graduate and Postgraduate level. He is professor of the International Course on Pedology (UNAM, Mexico) since 1995, and founder-Professor of the Doctorate Program on Environmental Sciences of the Universidad de Puebla, Mexico, 1995). Has delivered numerous lectures, keynote presentations in conferences, seminars and courses in many countries worldwide and is very active in international cooperation. He has participated in 23 research projects (most of them international) and directed 14 Thesis. Actually is member of the Steering Commitees of the EU COST Action “Putting Halophytes to work: from genes to ecosystems” (2009-2013) and participant in the EU COST Action “VALUE-Validating and integrating downscaling methods for climate change research” (2011-2015). Professor Batlle-Sales was Head of the International Relations Office of the Universidad de Valencia 1994-2000. He is acting as Secretary of the Commission 3.6 of Salt-Affected Soils of the International Union of Soils Science since 1994. Is the Spanish Representative of the FAO’s Global Network on Salt Affected Habitats (SPUSH) since 1995. Since 2009 is Vicepresident for Spain of the World Association for Soil and Water Conservation (WASWC) and leader of the Working Group on Soil Salinization and member of the Scientific Advisory Board of DESERNET International. Dr. Batlle-Sales has organized four International Symposia (ISSALE-95, SPUSH 2001, WCSS 2002-Workshop 33, and GFSCC2010) and many international courses and conferences dealing mainly with salinity arising problems on soils and waters. He is Associate Editor of two International Journals.

Salma DAOUD

Lecturer and researcher at Faculty of Sciences of Ibn Zohr University, Agadir, Morocco. She graduated from faculty of Sciences of Mohamed V University, Rabat Morocco on plant bacteriology and holds a Ph.D on plant ecophysiology from Ibn Tofail University, Kénitra, Morocco. She has 21 years of experience in teaching. Her research topics are focusing on the physiology of salt tolerance of halophytes and their sustainable utilisation for the reclamation and the rehabilitation of salt affected lands. She is also doing research on southern Morocco local productions (Saffron, prickly pear, Argane oil, ….) valuation. She is realisator and coordinator of professional Bachelor on: « Valuation of local products and know-how in the south of Morocco» in Ibn Zohr University. She is supervising a number of students for their research leading to Bachelor, M.Sc and Ph.D degrees on topics related to her research interest. She is also responsible for the team research: Stress Physiology and Metabolism in Plants in the laboratory of plant Biotechnologies in Faculty of Sciences, Agadir.

Irfan Aziz

Dr. Irfan Aziz, Associate Professor, Institute of Sustainable Halophyte utilization, University of Karachi has about 21 years of teaching & research experience. He was awarded the degree of M. Sc. in1992 and Ph. D. in 2001 by the University of Karachi. Dr. Aziz started his career as a Research officer in January1992 at the Department of Botany, University of Karachi. He joined a local college (under Sindh Education Department) as a Lecturer of Botany in 1995 and was promoted to the post of Assistant Professor in 2004. He was appointed as Assistant Professor in Botany, University of Karachi in 2006, Institute of Sustainable Halophyte Utilization in 2009 and promoted to the post of Associate Professor in November, 2013. Dr. Aziz is a life member of Pakistan Botanical Society and Pakistan Society for Biochemistry and Molecular Biology and has reviewed a number of articles published in Pakistan Journal of Botany, Aquatic Botany, International Journal of Physiology and Biochemistry, Journal of Tropical Forest Science and Environmental and Experimental Botany. He was selected as approved Ph. D supervisor by Higher Education Commission. Pakistan in 2007. His name was included in the list of "Productive Scientists of Pakistan" by Pakistan Council for Science & Technology, Islamabad in 2012 and he has also received "Research productivity Award" during the years 2007, 2011 and 2012. Dr. Aziz has also helped in developing M. Phil / Ph. D courses in Botany and Halophyte Institute where he is currently involved in teaching and research. He has done most of his research work on Physiological Ecology of woody halophytes with special emphasis on mangroves. His research work on seedlings and saplings of mangroves could be helpful in proper restoration as well as rehabilitation of coastal ecosystems. Currently he is in charge in one of the Ecophysiology Labs (Institute of Sustainable Halophyte Utilization) where he is helping Ph. D students on different techniques involved in Plant and soil water relations, contribution of osmolytes in osmotic adjustment and spectrophotometry.
He has published his research articles on seasonal water and solute relations, growth, antioxidant enzymes and other aspects of salt tolerance among coastal halophytes. Dr. Aziz has keen interest in learning modern techniques in plant water and osmotic relations including pressure probe technique and MIFE (Microelectrode Ion Flux Electrophysiology) for which he is seeking for funds to visit abroad on a post doctoral fellowship. These techniques would not only help in better understanding of tolerance mechanism in salt excluding and secreting halophytes but also help in developing non-conventional crops using saline resources for food, feed, fibre and medicines.

Shahina Ghazanfar

Shahina A Ghazanfar has worked in the Sultanate of Oman (Sultan Qaboos University), West Africa (Bayero University, Nigeria), Fiji (University of the South Pacific) and Pakistan (Pakistan Agriculture Research Council) and has made major contributions to the study of the floras of these countries. She joined the Royal Botanic Gardens Kew, UK, in 2001, initially as co-editor for the Flora of Tropical East Africa, and then as Head of the Temperate Regional Team, and Editor of the Flora of Iraq. She has a particular interest and expertise in the restoration, conservation and biogeography of the plants of the Middle East. Her interests and research extend to the study of halophytes and plants of medicinal, historical and economic importance of SW Asia. She has authored several books, chapters in edited books, and written peer reviewed papers on the floras and vegetation of Arabia and the Middle East.
Shahina's major contributions are as editor and author of Vegetation of the Arabian Peninsula (1998: Kluwer), Medicinal plants of the Arabian Peninsula (1994: CRC Press), Flora of the Sultanate of Oman (2003: Vol. 1, 2006: Vol. 2, Vol. 3 (in press) National Botanic Garden of Belgium), Scrophulariaceae for Flora of Tropical East Africa (2011), Halophytes of SW Asia (Sabkha Ecosystems: Springer, in press) and is currently preparing a checklist of the plants of the Middle East.

She is involved in major restoration and conservation projects in the UAE and advises on native plants for restoration of degraded habitats and for landscaping and horticulture.

Shahina A Ghazanfar has a PhD from the University of Cambridge, UK, and an MSc from Punjab University, Pakistan.

Brent Nielsen

Dr. Brent L. Nielsen is a Professor in the Dept. of Microbiology & Molecular Biology at Brigham Young University in Provo, Utah, U.S.A. He earned his Ph.D. in Microbiology (molecular biology emphasis) at Oregon State University and received postdoctoral training at the Univ. of California, Irvine where he worked on chloroplast molecular biology. He was on the faculty at Auburn University in Alabama for 12 years, and moved to BYU in 2000. He served as chair of his department from 2005-2011. He is a member of the American Society for Biochemistry and Molecular Biology and the American Society of Plant Biologists. He received the College of Biology & Agriculture Professorship at BYU for 2005-2006 and the Auburn Alumni/Sigma Xi Research Award in 1998. Dr. Nielsen has received a total of more than $2.5 million in external research funding, and has more than 50 peer-reviewed journal publications. Five Ph.D. and seven M.S. students have completed their work under his direction, and two Ph.D. students are currently working with him. Six postdoctoral fellows have worked under his direction. Dr. Nielsen works actively as an ad hoc reviewer for several molecular biology and plant biology journals (8-9 manuscripts per year) and for the National Science Foundation and other public and private granting agencies (1-2 proposals per year). Most of his research has focused on the analysis of plant mitochondria and chloroplast genome replication and recombination, along with proteins involved in these processes. Dr. Nielsen has collaborated with Drs. M. Ajmal Khan and Bilquees Gul for the past several years on the molecular biology of halophytes, most recently on the transcriptome and proteome analysis of Suaeda fruticosa, with funding from the U.S. Dept. of State and the Higher Education Commission of Pakistan.

Rainer Hedrich

Rainer Hedrich pioneered the biology of plant ion channels and is one the very few leaders in this field. He introduced the patch clamp technique into the plant field by demonstrating for the first time the existence of plant ion channels (Nature 1987). His ground-breaking Discovery resulted elucidation of the structure-function relationships of plant ion channels, established the key role of ion channels in plants and inspired the formation of a new research field, which is part of today's plant biology text books (Nature 1984, 1987, 1991). His lab made outstanding contributions to uncover the functions of plant ion channels, co-transporters and pumps. The Hedrich lab showed crucial functions of these proteins for plant physiology and development. Using physiological und molecular-genetic and molecular-genetic analysis his lab revealed the voltage and pH sensor of plant potassium channels, uncovered their selectivity filters, demonstrated the interaction sites of important components to channel proteins and studied subsequent signalling events (PNAS 2003, 2009, 2010, 2011). Besides of his strong position the transport field (Plant Cell 2006, 2008) Rainer Hedrich is a leader in the field of guard cell turgor and osmoregulation (PNAS 2007). Recently he succeeded in reconstitution of the fast ABA signalling pathway of guard cells from receptor to anion channels activation, via protein phosphorylation, by using a drought stress protein kinase/phosphatase pair (PNAS 2009). Besides of basic research, the Hedrich lab contributed to the development of new model systems by elucidating the molecular basis of endocrinology of carnivory by studying fast plant (PNAS 2011).Based on his contributions Rainer Hedrich received the following awards: 1984 Heinz-Maier-Leibnitz-Price of the German Science Foundation (DFG), 1989, Gerhard-Hess-Advancement Award of the German Science Foundation (DFG), 1991, Heisenberg-Stipend of the German Science Foundation (DFG), 1999, Comenius Award (Scientific films) for excellent collegiate didactics, 2001, Körber Award for the European Research, 2003, highly cited researcher among 250 in animal and plant sciences, ISI Web of Knowledge (http://researchanalytics.thomsonreuters.com/highlycited/browse/), 2010, European Research Council (ERC) Advanced Grant Award.

Muhammad Zaheer Ahmed

Dr. Muhammad Zaheer Ahmed did his Ph. D on seed germination of halophytes to observe 1) the role of environmental factors, 2) osmotic and ionic effect of salt, and 3) role of dormancy regulating chemicals. His research contribution could help in determining the appropriate time and place for successful seedling establishment of potentially important halophytes naturally found in playa habitats. Dr. Ahmed also visited Japan on a scholarship (HEC- Pakistan and JSPS-Japan) where he completed his studies on population diversity of Aeluropus lagopoides (a high salt tolerant wild relative of wheat) and observed that the fragmentation in a single meta-population of A. lagopoides is due to the anthropogenic activity, while physical disturbances supports higher genetic diversity within populations. In addition, Dr. Ahmed also studied that A. lagopoides could survive in high salinity by regulating Na+ transport and K+ homeostasis with the help of V-NHX, PM-NHX and V-ATPase genes. This molecular information on salt tolerant grass might be useful in the field of genetic engineering. His recent research interests include studies on responses in sabkha halophytes during salt shock and gradual application of salt. More specifically, he focusses on the absorption, transport and secretion mechanisms of ions (Na+ and K+) under variable salinity regimes. Dr. Ahmed's research plan could provide an insight for decreasing Na+ toxicity and maintaining K+ homeostasis of salt tolerant species growing naturally in degraded ecosystems. A number of such halophytes could be useful as alternate sources of medicine, fodder, food and biofuel. His research could help in improving conventional crop production using saline irrigation.

Hans W. Koryo

I am actually holder of two professorships in Gießen a) Professor of Botany, Plant Ecology and Ecotoxicology at the University of Applied Sciences (THM) in Giessen and b) Professor of Plant Ecology and Botany at the Justus-Liebig-University (JLU) of Giessen. In addition I am managing director of the IFZ greenhouse, the greenhouse of Plant Biology and of the Open-Top-chambers (OTC, elevated atmospheric CO2 concentrations) at the JLU. Thematic priorities of my research are the ecophysiological and ecotoxicological responses of plants at extreme habitats (Extremophytes) of the arid-semiarid area and with special emphasis on the following aspects:

1. Development of highly reproducible and optimized quick check systems (QCS) for Extremophytes.
2. Influence of Biochar on the plant response at extreme soil or/and climate conditions.
3. Exotoxicology of Xenobiotics.
4. Ecophysiology of Xero- and Hydrohalophytes. Determination of the mechanisms enabling or disabling growth on dry, flooded and/or saline habitats.
5. Study of the plant responses and resistances to nutrient stresses such as drought, salinity and heavy metal. Study of the major constraints: Study of water, CO2 and nutrient deficiency, ion toxicity, photosynthesis (H2O/H2O gas-exchange and chlorophyll fluorescence) and ROS stress from whole plant to cellular level (such as proteomic of crops under abiotic stress).
6. Influence of elevated atmospheric CO2, N2O and CH4 concentrations on plant metabolism and plant/soil interactions (global changes).
7. Cash Crop Extremophytes: Screening of the drought, heavy metal and or salinity resistance of

xero– and hydrohalophytes but also of halophile glycophytes with a potential for crop production on dry, heavy metal or saline soils. Study of energy consumption, protein and mineral nutrition, catabolism and anabolism.
8. Forage (cultivated drought- or salt-resistant fodder crops and natural rangelands) evaluation and utilization
9. Utilization of halophytes as animal feeds. Impact of drought, salinity, heavy metals etc. on livestock production or biofuel quality.

Sergey Shabala

Dr Sergey Shabala is a Professor in Plant Physiology at the University of Tasmania, Australia and a co-Director of the Australia-China Research Centre for Plant Stress Biology. His major expertise is in stress physiology and membrane transport in plants. His 29 years expertise in the field has resulted in several books and over 160 publications in leading international peer reviewed journals, over 3,700 citations and H-index of 35. He is currently supervising 21 PhD students working on various aspects of plant adaptive responses to salinity, waterlogging, drought, soil acidity, and oxidative stress. Over the last 12 years he has obtained over $5M in competitive research funding for a range of basic and applied projects in plant stress biology, including seven ARC Discovery grants. He is currently serving as an Editor or editorial board member on six international plant science journals. In addition to this, he is routinely reviewing 50-60 papers per year for leading international journals and acts as a reviewer for major funding bodies from over 15 countries including Australia, USA, and UK. Prof Shabala's current research focus is on identifying physiological mechanisms conferring salinity tolerance in halophytes that can be introduced into non-halophyte crop species to improve their performance under saline conditions. The specific traits targeted by his group include sodium sequestration by salt glands and bladders; increasing the efficiency of internal Na+ sequestration in vacuoles by the orchestrated regulation of tonoplast NHX exchangers and slow and fast vacuolar channels; efficient control of xylem ion loading and cytosolic K+ retention; and controlling stomata aperture and optimising water use efficiency by altering stomata density. He is also involved in several research projects aimed at the use of halophytes as a viable commercial alternative to traditional crop and pasture species to ease pressure on the requirement of good quality land and water for conventional cropping systems and the utilization of land degraded by salinity.

Ismail Turkan

Prof. Turkan has graduated Department of Botany, Faculty of Science at Ege University in Izmir, Turkey in 19890. He has got his Ms and PhD degrees in Department of Biology at Ege University in the year of 1982 and 1987 respectively. He has been studied as post-doc researchers in Tohoku , Chiba and Kumamoto Universities under the fellowship of Ministry of Education (MONBUSHO) , Goho Life Science Foundation and JSPS in Japan. Now he is working as a full professor in Department of Biology, at Ege University. Formerly, he has been a visiting professor to Graduate School of Life Science at Tohoku and Kumamoto Universities of Japan. Up to now, he has published more than 50 papers and his papers has been cited more than 1300 in SCI and SCI Expanded Journals. He also has been acting as a member of Editorial boards of Environmental and Experimental Botany and also he acted as guest editör of Advances of Botanical Research in 2011 for a special issue on "Plant Responses to Drought and Salinity Stress: Developments in a Post-Genomic Era. He is a reviewer of more than 30 well known international journals. He is Turkish Representative of European Plant Biological Society (FESPB).

Presently, in his laboratory, he and his group are studying on the physiological, biochemical and molecular characterization of plants under drought and salt stress, oxygen free radicals and antioxidants in plants and plant signaling under stress.

Salman Gulzar

Dr. Salman Gulzar works on the ecophysiology of seed germination and growth in influencing distribution of perennial halophytes along environmental gradients and has published a number of papers in reputed international journals. Recent research interests include the role of C3, C4 salt marsh halophytes in global CO2 sequestration. More specifically, he focusses on leaf level adaptations in gas exchange and chlorophyll fluorescence, δ13C isotope discrimination under variable light, CO2, salinity and moisture regimes. Dr. Gulzar's research could provide insights for improving the photosynthesis and biomass production of salt tolerant species growing naturally in degraded ecosystems. Many of these halophytes could be useful as alternate sources of medicine, fodder, food and biofuel. His research could also contribute towards the sustainable management and conservation of coastal plant communities.

Miguel Clüsener-Godt

Mr Clüsener-Godt is German and has a Ph.D. in Biology/Ecology from the University of Bielefeld in Germany. Moreover, he has a PhD. Honoris causa of the University of Para, Belem, Brazil. He is a Senior Programme Specialist in the Division of Ecological and Earth Sciences in UNESCO Headquarters in Paris, and he is the Chief of the Section for Ecological Sciences and Biodiversity. He Is responsible for Latin America and the Caribbean and IberoMAB Network, as well as the Macaronesian and the Pacific Region. Principle fields of activities are South-South Co-operation on Environmentally Sound Socio-Economic Development in the Humid Tropic, the World Network of Island and Coastal Biosphere Reserves, Coastal Zones and Small Islands, the REDBIOS Network in the East-Atlantic and Asia Pacific Co-operation for the Sustainable Use of Renewable Natural Resources in Biosphere Reserves and Similarly Managed Areas. Within UNESCO/MAB, he published the World Atlas of Mangroves, in cooperation with FAO, ISME, ITTO, UNESP/WCMC, UNU/INWEH and TNC in 2010. Finally, he is a co-author of the Policy Brief on "Securing the Future of Mangroves", 2012.

Munir Ozturk

Dr. Münir ÖZTÜRK holds a D.Sc. in Plant Eco-Physiology from the Ege University, Izmir-Turkey. Has has participated in 15 national and 2 EU projects together with Greece, Lebanon, Egypt, Tunisia, Germany and Italy. Worked at Munich Technical University-Germany as Alexander Von Humboldt fellow, in Tohoku University-Japan as JSPS fellow, at the University of Chapel Hill-USA under NSF programme. Dr. Öztürk has served as chairman of Botany followed by Founding Director "Centre for Envirornmental Studies", Ege University, Izmir, Turkey, and has 18 memberships in different institutes and professional bodies including "Fellow of the Islamic Academy of Sciences and Member Interdisciplinary Committee of the World Cultural Council-Albert Einstein Award of Science".He has been honoured by several awards and two species have been recorded after his surname in the scientific literature Sideritis ozturkii and Verbascum ozturkii. Dr. Öztürk has published /edited over 30 books including well cited volumes from the Springer, Elsevier, Birkhauser Verlag, and Cambridge Scholars. He has acted as guest editor for several International Journals, has produced over 400 papers in the field of ecology and biomonitoring. Dr. Ozturk has worked with government and private universities, with NGOs, and recently as a Consultant Fellow at the Faculty of Forestry, University Putra Malaysia, Selangor-Malaysia and as “Distinguished Visiting Scientist” at the ICCBS, Karachi University, Pakistan.

Mark Sutcliff

Mark Sutcliffe is currently serving as a project officer in the Natural Science section of UNESCO in Doha. With broad international experience, he works on developing and implementing sustainable solutions based on his business and science background. UNESCO Doha is involved in a wide variety of projects such as the management of biosphere reserves, marine protected areas, raising environmental awareness, and developing publications such as an up to date species checklist for Qatar.

Abdul Hameed

Dr. Abdul Hameed, Assistant Professor, Institute of Sustainable Halophyte Utilization (ISHU), University of Karachi, Pakistan, is investigating the roles of reactive oxygen species (ROS) and antioxidant defense system in salinity tolerance of halophytes at both seed germination and growth stages. He aims to combine classical eco-physiology techniques with modern molecular approaches to better understand salinity-induced oxidative stress tolerance in halophytes. The ultimate goal of his research is to enhance salinity tolerance of important cash crop halophytes by way of improving their antioxidant defense. In this regard, he is examining the efficacy of exogenous application of different chemicals such as ascorbic acid to improve seed germination and growth of halophytes under high salinity conditions. Recently, he is focusing more on seed germination stage, which constitutes the main propagation way of most plants. Dr. Hameed has published a number of research articles in renowned international/national journals on aforementioned aspects, which are frequently cited.

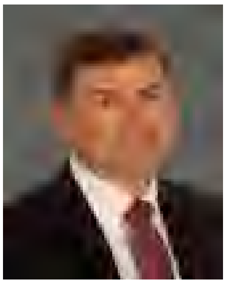
Karim Bin Hamid

Dr. Karim Ben Hamed received his PhD in biology engineering from the “Ecole Nationale d’Ingénieurs de Sfax”. He then joined the Centre of Biotechnology of Borj Cedria (CBBC) in Tunisia as an assistant Professor. He is now working on his Habilitation to conduct research (HDR) in plant biotechnology. Dr. Ben Hamed is working currently in the laboratory of extremophile plants at CBBC, Tunisia where he leads a project on the mechanisms of salinity tolerance in model halophytes. He conducts research to understand the molecular mechanisms underlying plant responses to harsh environments such as soil salinity, drought and oxidative stress. He plans to use a combination of genetic, genomic and transcriptomic approaches to analyze various levels of gene regulation and to understand stress signalling and stress tolerance.

A.K.M. Nazrul-Islam

Dr. A. K. M. Nazrul Islam is Bangladeshi and did his B. Sc. Hons. and M.Sc. from the University of Dhaka. He did his Ph. D. in Physiological Ecology from the University of Sheffield, U.K. in 1977. He joined in the Department of Botany in 1970 as a Lecturer and as a Professor in 1988. He supervised 24 M.Sc. students and 5 Ph. D. scholars. He examined more than 30 Ph. D. Thesis of the various universities from India and Nepal. Attended number of courses in Italy, India, Sri Lanka; Presented paper in the International Symposia in Europe, India, Pakistan, Nepal, and Bangkok. He was the Chairman of the Department of Botany and also was in charge (short time) of the Dean of the Faculty of Biological Science. Dr. Nazrul Islam awarded Justice Ibrahim Memorial Gold Medal for outstanding Research Publications as a single author; 1995 – 1996. He also received Associate ship by International Centre for Theoretical Physics (ICTP), (1999 – 2005) Trieste, Italy. He served as a member of Syndicate in the Rajshahi Engineering University and Technology (RUET). He has published 63 research papers in various scientific journals at home and abroad. He worked as Environmental experts in various World Bank Projects.

Paul Bierman-Lytle



Mr. Paul W. Bierman-Lytle, AIA, LEED AP BD+C, received his M. Arch. Degree from Yale University School of Architecture. He has been founder and President of SEAS Corporation for over 30 years, winning awards internationally and receiving coverage on CNN, ABC, PBS, German, Australian and Japanese television and print media. From 1990-1993, he was co-founder of the prestigious American Institute of Architects' Committee On The Environment (COTE), and chairman on Materials & Resources. COTE was instrumental in launching the United States Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED). He was recently honored with the USGBC Leadership Award and AIA Presidential Citation as one of the "founders of green design in the United States." At CH2M HILL, one of the largest engineering/architectural firms in the USA, Mr. Bierman-Lytle was V.P. Executive Director of Sustainability. In this capacity, he was a key delegate to HRH Prince of Wales International Hotel Environment Initiative in London; and to the World Business Council on Sustainable Development in Geneva. Mr. Bierman-Lytle has been chief architect and planner on numerous mixed use development projects worldwide, including the USA, Mexico, Costa Rica, India, Oman, UAE, and Qatar. His specialty is developing integrated interdependent utility and infrastructure companies to support sustainable communities. Each of his projects target 'profitability' as an outcome of strategic ecosystem principles, materials, methods, and solutions.

Mr. Bierman-Lytle is co-author of Your Natural Home, published in 1995 by Little Brown & Company, New York; he was Editor-in-Chief of the famous Yale Architectural Journal, Perspecta 17, published by MIT Press. He has lectured in over 250 universities and conferences worldwide and has been a visiting professor at Yale University, UCLA, and Technische Universitat in Braunschweig, Germany. He is a licensed architect in California and Connecticut, and a USGBC LEED Accredited Professional since 2003. He is also a member of the infamous Explorer's Club, headquartered in New York City.

Mr. Bierman-Lytle is currently President of the Board of Directors and CEO of Pangaeon, an international company focused on developing eco sports and adventure parks that feature over 150 sports in water, land, and air. The goal of these park resorts is to provide healthy physical activity for all ages, all skill levels, and all cultures, supported by a unique infrastructure of systems based on sustainability principles, including energy, water, waste, sewage, transportation, communications, air quality, and cultural heritage.

Kenneth B. Marcum

Dr. Kenneth B. Marcum has served in research, teaching, and extension (industry and government outreach) capacities, primarily in university faculty positions, but also for national governments. He has worked in a number of countries in Asia, Southeast Asia, Pacific, Europe, Caribbean, as well as in the U.S.A., and currently holds a faculty position at United Arab Emirates University in Abu Dhabi. He is the recipient of many research grants, including national research fellowships in Australia, Italy, and Japan. His expertise is in deficit irrigation systems, water and soil salinity management, salinity tolerance breeding, and urban xeriscapes. He has been involved in the successful development of a number of halophytic grass species, including the release of cultivars for the urban landscape industry.

Jose M. Pardo

Dr. Pardo received his B.S. in Biology from the Universidad de Sevilla, Spain, and his Ph.D. in Biology at Centro de Biologia Molecular, Universidad Autonoma de Madrid, Spain. He has worked on the biochemical basis of resistance to antibiotics in the producing Streptomyces, the genetic engineering of extracellular glucoamylases of Saccharomyces for the production of beer with low carbohydrate content, and the mechanism of action of antifungal PR-5 plant defense proteins. His current research includes molecular and genetic analysis of plant responses to salinity and drought stress in Arabidopsis and rice to identify critical components in stress tolerance. He funded the Spanish Network on Plant Abiotic Stress and has served as Manager of the National Biotechnology Program. Dr. Pardo has been Visiting Professor at the Center for Plant Stress Physiology, Purdue University, USA and the Plant Stress Genomics Research Center, King Abdullah University of Science and Technology, Thuwal, Kingdom of Arabia Saudi. He has authored over 60 research papers and book chapters that together have received more than 4.300 citations.

Profile in ORCID: Jose M. Pardo (http://orcid.org/0000-0003-4510-8624)

Munawar Ahmad

Dr. Munawar received his PhD in plant molecular biology from the Gyeongsang National University, South Korea. He had been involved in teaching and research at the Faculty of Biological Sciences, Kohat University of Science and Technology, Kohat, Pakistan.

During his career he has been involved in several projects of crop improvement with both conventional and non-conventional techniques. These include Wheat Breeding program, Genetic Transformation in Citrus root stocks and Genetic diversity in wild oat (Avena spp) collection from various regions of Pakistan.

Dr. Munawar Ahmad had been involved in several projects of basic molecular biology using Arabidopsis Model plant. These project include Development of FRET Based sensor for in vivo detection of auxin flux, Genetic dissection for intra- and intercellular trafficking of small interfering RNA pathways in Arabidopsis by activation tagging and Genetic screening for the Cell-to-cell trafficking transcription factors in Arabidopsis.

Recently Dr. Munawar Ahmad has joined the Department of Biological and Environmental Sciences, College of Arts and Sciences at Qatar University. He is interested in involving in projects deciphering the molecular mechanisms underlying plant responses to salinity particularly in the wild salt tolerant species.