Current Status of Biotechnology Research and Development (R & D) at NENA Region

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Introduction
West Asia and North Africa (WANA) Region

- The WANA region is the origin of many vital food crops such as wheat, barley and lentils for the World.
- In ancient times, the WANA region was the bread basket of various empires.
- This region is now a major net importer of food!!
WANA Region (cont.)

The region has several development problems, among them, poverty, lack of gainful livelihoods, shortage of water, droughts and desertification, and conflicts.

The region has not emphasized, taking an overview, agricultural development and developing capacities in agricultural research.

This has long term implications for the region’s food security and civil security of Europe, West and Central Asia, the Arabian Peninsula and North Africa.
Constraints to Sustainable Agricultural Development in WANA

- typical fragile ecosystems of dry areas
- hot spot for climate change impact
- water scarcity & drought is becoming a common phenomenon
- land degradation & desertification
- population boom & poverty
- weak investment in agricultural research for development
- Inadequate policies
- Geo-politically fragile environment
- gender imbalance
- constraints in human resources and institutional capacities
- the largest food deficit region in the world
AARINENA MISSION

• To contribute to the enhancement of agricultural and rural development in the WANA region through fostering agricultural research and technology development.

• To promote the exchange of scientific and technical experience and information.

• To strengthen collaboration within and outside the region to achieve greater degree of self-sufficiency in food and agriculture.
Recent advances in biotechnology applications provide good opportunities for immediate benefits to the WANA region. The applications made in the region include the development of micro-propagation systems for many plant species.

Most of the commercial applications in modern biotechnology advances have occurred in developed countries.

Much of the expertise is concentrated in the commercial private sector, thereby restricting developing countries’ access to patented technology.

Technical cooperation networks have become a generic model for the establishment of functional mechanisms for collaboration and enhancement of communication and exchange of experiences among different countries in the region and other regions.
In order to reduce duplicative efforts among national institutions in several countries and to provide a cost-effective instrument for information exchange and institution building & to strengthen research partnership in the Region, AARINENA has established 7 regional research networks for Date-Palm, Cotton, Olive, Medicinal & Aromatic Plants, Water Use Efficiency, Agricultural Biotechnology and Plant Genetic Resources.

These networks are contributing to the generation of information, training, extension and inter-regional research and development programs in the WANA region and with other Regional Networks such as APAARI -APCoAB & INCANA.
AARINENA Regional/Inter-Regional Networks

AARINENA has established 7 Regional Networks in collaboration with GFAR, FAO and ICARDA:

1. Date-Palm Global Network (DPGN),
2. Inter-Regional Cotton Network,
3. Regional Olive Network,
4. Regional Medicinal & Aromatic Plants and
5. Water Use Efficiency Network
6. Agricultural Biotechnology Network
7. Plant Genetic Resources
Geographical Distribution of AARINENA Networks

Tunisia
Olive Network

Jordan
Medicinal & Aromatic Plants

UAE
Date Palm Global Network

Iran
Int. Reg. Cotton Network

N.A. (Maghreb) Sub-Region

Mashreq Sub-Region

Arabian Peninsula Sub-Region

Wes Asia Sub-Region

Morocco
WUE

Tunisia
Olive Network

Egypt
Biotechnology AGERI-ARC

Nile valley Sub-Region

Mashreq Sub-Region

Sudan
Plant Genetic Resources N

APAARI Expert Consultation Meeting - Taiwan Agric. Res. Institute, Taichung, Taiwan 27-28/10/2011
Regional Agricultural Biotechnology Network

www.rabnena.net

- AARINENA / GFAR / FAO / ICARDA / ARC expert consultation, December 2007, Cairo, Egypt.

- 18 Agriculture Biotechnology experts from 14 countries of the region and AARINENA, ICARDA, FAO and GFAR experts attended the consultation.

Location: AGERI / ARC – Egypt. Secretariat (www.rabnena.net)
Network Secretary: Prof. Dr. Osama A. Momtaz / AGERI, Egypt.
Network Board Chair: Dr. Yousef Al-Shayji / KISR, Kuwait.
### Four Working Groups have been formed:

<table>
<thead>
<tr>
<th>Working Group</th>
<th>Task</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>WG1</td>
<td>Omics and Molecular Markers Technology</td>
<td>ABRII – Iran</td>
</tr>
<tr>
<td>WG2</td>
<td>Gene transfer, Expression and Regulation</td>
<td>SFAX – Tunisia</td>
</tr>
<tr>
<td>WG3</td>
<td>Biosafety, Intellectual Property Rights (IPR)</td>
<td>GCSAR – Syria</td>
</tr>
<tr>
<td>WG4</td>
<td>Bioinformatics and Knowledge Management</td>
<td>AGERI – Egypt</td>
</tr>
</tbody>
</table>
SWOT Analysis of Biotechnology in WANA Region

SWOT Analysis of Biotechnology In WANA Region
1. Strengths of Biotechnology in WANA Region

STRENGTHS of Biotechnology In WANA Region
• Steady increase in the recognition of the role of Biotech.
• Increase in number of functional labs. and research staff.
• Many WANA countries have nucleus of basic infrastructure and trained personnel for tissue culture, molecular biology in plants, animals and Biomedicine.
• Tissue culture and Molecular markers are the main application and are already in widespread use across the region.
• Some AARINENA countries also have capacities for producing GM crops (Egypt, Iran, Turkey....). Genetic engineering is increasingly finding a wider application.
• Regional network : AARINENA Regional Agricultural Biotechnology Network based at AGERI-Egypt.
• **FAO Regional Project – TCP/RAB/3202** Strengthening capacities towards the establishment of a regional platform for the detection of genetically modified organisms".

http://rabanena.net/FrontEnd/BestPractice/BestPractices.aspx?lang=EN and
http://www.rabanena.net/FrontEnd/BestPractice/BestPracticeDetails.aspx?Id=40（=EN）
## Current Status of Biotechnology Application in WANA Region

<table>
<thead>
<tr>
<th>Biotech application</th>
<th>Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tissue culture applications</td>
<td>Algeria, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Morocco, Syria, Tunisia, Turkey, United Arab Emirates</td>
</tr>
<tr>
<td>Micro-propagation</td>
<td></td>
</tr>
<tr>
<td>Doubled haploids</td>
<td>Algeria, Iran, Morocco, Sudan, Syria, Tunisia</td>
</tr>
<tr>
<td>Cell cultures</td>
<td>Egypt, Morocco, Tunisia, United Arab Emirates</td>
</tr>
<tr>
<td>Molecular breeding</td>
<td>Algeria, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Morocco, Syria, Tunisia, Turkey</td>
</tr>
<tr>
<td>Genetic Engineering</td>
<td>Egypt, Iran, Morocco, Syria, Tunisia, Turkey</td>
</tr>
<tr>
<td>Genomics</td>
<td>Egypt, Iran, Syria, Tunisia, Turkey,</td>
</tr>
<tr>
<td>Proteomics</td>
<td>Egypt, Iran,</td>
</tr>
</tbody>
</table>

Source: Hamdan 2008; Momtaz et al. 2010
Status (cont.)

- Along the gradient of biotechnology tissue culture and micro-propagation techniques are commonly used in the WANA Region.
- Molecular marker techniques are widely used, but not yet effectively.
- Genetic engineering is increasingly finding a wider application.
- More upstream technologies (genomics, proteomics etc) are restricted to a few institutes.
- With a more widespread research but also beginning of commercialization of GMOs their effect on biodiversity needs to be investigated in order to explore ways to maintain and protect biodiversity.
**STRENGTHS**

- Biotechnology is the fastest-growing industry.
- Some of the biotechnology products are used to improve animal production & productivity (feed additives, vaccines, etc).
- Availability of trained & skilled human resources.
- Political commitment (many countries in WANA region have the biosafety protocol).
- Establishment of CGIAR centers, NARS, Universities.
- Presence of information sharing structure (FAO, ILRI, ICARDA).
- Development of strategy for the establishment of biotechnology in WANA region.
Biosafety Status in the Region

- Biosafety legislation developed by Egypt in 1995 and biosafety guidelines in Syria in 2001 with proposed biosafety law underway.
- 11 Countries have completed their NBF under UNEP-GEF projects:
  - Algeria, Egypt*, Iran, Jordan, Lebanon, Mauritania*, Tunisia*, Yemen, Syria, Morocco, Libya
- 2 Countries developing NBFs without GEF support:
  - Oman, Saudi Arabia

*These countries completed their NBFs under the UNEP-GEF pilot projects 1997-99

FAO Regional Project – TCP/RAB/3202

http://rabsena.net/FrontEnd/BestPractice/BestPractices.aspx?lang=EN and
http://www.rabsena.net/FrontEnd/BestPractice/BestPracticeDetails.aspx?Id=40≤EN
2. Weakness of Plant Biotechnology in WANA Region
• A broad public debate has not taken place.

• Potential impact on nature and the environment.

• Lack of full technical expertise and trained staff in different modern biotechnology applications.

• Lack of functioning biosafety systems and standardized procedures for the management of GMOs at various ports of entry.

• More upstream technologies (genomics, proteomics, GE, etc) are restricted to a few institutes.

• Lack of funding, national commitment, political will, good governance, wise policies, appropriate infrastructure and investment.

• Little integration of biotechnology in national policy framework

• Important local crops and small holder farmer problems not addressed

• Limited in public resources and investments

• Tools for technology transfer inadequate and often inaccessible

• Lack of institutional capacity

• Dialogue among stakeholders is lacking
Trained staff in different modern biotechnology methods as well as GMOs detection and monitoring is required in some countries.

Lack of modern molecular biology equipment and containment facilities.

The most important gaps for GMOs detection are:

- The absence of biosafety regulations in most ARRINENA countries.
- The lack of funds.
- The lack of technical expertise for GMOs detection (mainly quantitative).
- The absence of appropriate infrastructure (In-containment glasshouses and others) to pursue the studies on GM plants after the first laboratory tests.
- The deficiency of human skills specialized in genetic engineering.
- The lack of funds.
Limited R & D programs on modern livestock biotechnology.

Lack of policies on livestock biotechnology & biosafety at regional level.

Lack of focus (livestock species) and continuity.

Underutilization of the available biotechnology facilities.

Lack of specialized livestock biotechnology laboratory.

Commercialization issues.

Limited application of modern livestock technologies.

Lack of sustainable funding.

Absence of a regional technical cooperation network.
3. Threats / Challenges of Plant Biotechnology in WANA Region

THREATS / CHALLENGES
• Absence of national strategies addressing the use and integration of biotechnology in the agricultural sector.

• The lack of cooperation, dialogue among stakeholders (academia, research, industry, private sector and government).

• Absence of biosafety legislations and insufficient attractive Investment Laws.

• The deficiency of human skills.

• Important local crops and smallholder farmer problems not addressed.

• Tools for technology transfer inadequate and often inaccessible.

• Limited national funding and investments / mostly overseas.

• Inadequate infrastructure and supporting facilities

• Limited added-value
The major gaps that are limiting the development of Biotechnology applications in the region are:

- The absence of a national strategy addressing the use and integration of biotechnology in the agricultural sector.
- The lack of cooperation between academia, research, industry and government.
- The absence of biosafety legislations.
- The absence of appropriate infrastructure (glasshouses and others) to pursue the studies on GM plants after the first laboratory tests.
- The deficiency of human skills specialized in genetic engineering.
- The lack of funds.
Major Challenges Facing Agricultural and Biotech. Sector in WANA Region

- Insufficiency of Attractive Investment Laws
- Limited integration of Modern Agricultural biotechnology in national policy framework
- Insufficiency of Infrastructure
- Important local crops and small holder farmer problems not addressed
- Limited in public resources and investments
- Tools for technology transfer inadequate and often inaccessible
- Lack of institutional capacity
- Dialogue among stakeholders is lacking
- Limited Added-Value
Major Challenges Facing Agricultural and Biotech. Sector in WANA Region

- Limited expertise and narrow scope
- Limited national funding /mostly overseas
- Little involvement of private sectors
- Inadequately equipped labs & supporting facilities
- Insufficient local suppliers
- Lack of product oriented research strategies /mostly educational
- Non-operational Biosafety system
- With a more widespread research but also beginning of commercialization of GMOs, their effect on biodiversity needs to be investigated in order to explore ways to maintain and protect biodiversity.
Some Real Problems to consider:

- Public awareness and acceptance
- Patents
- Intellectual property rights

The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) under the World Trade Organization, establishes minimum standards of IPR protection. According to the TRIPS agreement, plant varieties must be protectable either by patents or by the breeder’s rights provided in the conventions of UPOV.

- Farmers ‘and indigenous peoples’ knowledge.
- Ethical Issues

http://lists.ifas.ufl.edu/cgi-bin/wa.exe?A2=ind0405&L=sanet-mg&D=0&P=9245
Integrating the best outputs of Plant Biotechnology (tissue culture, drought and salinity tolerant crops, biopesticides and biofertilizers, MAS, Food, Medical and Environmental Biotechnology, Research Materials and Tools.)

- Improvement of crops for biotic and abiotic stress using conventional and biotechnological methods (drought tolerance.).
- MAS for the crops of the poor
- Enhancing incomes through agricultural diversification and added-value.
- Providing support for capacity building in agri. Biotech. addressing in particular GMO production and risk assessment.
- Use of transformation technology and genetic engineering to incorporate genes of interest into major crops (wheat, legumes,…).
- Ensuring the judicious and wise use of modern biotechnology in order not to jeopardize the environment and human health.
- Engineering new traits in elite cultivars.
- Understanding societies’ expectations and international regulations on handling GMOs.
THREATS of Livestock Biotech.

- Brain drain, senior trained & skilled professionals are moved to management positions.
- Lack of networking among livestock scientists.
- Private sectors are much less attracted on livestock biotechnology business.
- Consumers concern regarding livestock biotechnology products.

OPPORTUNITIES of Livestock Biotech

- Livestock sector is becoming increasingly important in WANA region
- Availability of new research tools such as biotechnology.
- The availability of the first report on the “State of the World’s Animal Genetic Resources” including the WANA region.
- High commitment from regional governments & donors to support indigenous AnGRs improvement and conservation projects.
- Availability of trained manpower.
- Current research priorities of the CGIAR centers (sustaining agriculture biodiversity for future generation & producing more & better food at lower cost through genetic improvements).
<table>
<thead>
<tr>
<th>Country</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jordan</td>
<td>Veterinary medicine and animal production: Uses of hormones sponges, PCR, ...</td>
</tr>
<tr>
<td>Iran</td>
<td>Production of traditional and recombinant vaccines and serums for livestock &amp; poultry</td>
</tr>
<tr>
<td>ILRI</td>
<td>Development of molecular probes for disease diagnosis in livestock and product safety</td>
</tr>
<tr>
<td>Kuwait</td>
<td>Application of embryo transfer techniques. Development of DNA fingerprinting techniques for marine species, and development of molecular probes for disease diagnosis in livestock</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>Molecular Classification of Saudi Arabian camel based on RAPD techniques</td>
</tr>
<tr>
<td>ILRI</td>
<td>Improving animal genetic resources characterization</td>
</tr>
<tr>
<td>ILRI</td>
<td>Improving farm animal genetic resources</td>
</tr>
<tr>
<td>FAO member developing co.</td>
<td>Biotechnology-related policies, regulations, etc on animal genetic resources</td>
</tr>
<tr>
<td>Egypt</td>
<td>Production of immunological diagnostic kits, Screening for organisms that have a potential biotechnological application, and Animal and human cell culture on veterinary applications</td>
</tr>
<tr>
<td>Lebanon</td>
<td>Diagnosis of animal diseases (using RT-PCR)</td>
</tr>
<tr>
<td>Cyprus</td>
<td>Genetic analysis of blood samples to select genotypes resistant to scrapie disease, genetic, and resistance of the olive fruit fly, Bactrocerae oleae Gmelin to organophosphate, ...</td>
</tr>
<tr>
<td>Morocco</td>
<td>Immunological diagnostic</td>
</tr>
<tr>
<td>Sudan</td>
<td>Production of vaccines, Artificial insemination to improve the genetic make up and productivity, Embryo transfer (ET) in bovine, and diagnosis of viral and parasitic diseases</td>
</tr>
<tr>
<td>Syria</td>
<td>Embryo transfer, diagnosis of animal diseases, production of animal vaccines, fingerprinting of Alawasi local sheep, and animal and human cell culture</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>Phenotypic and molecular characterization of Ethiopian cattle, small ruminants, ...</td>
</tr>
<tr>
<td>ICARDA</td>
<td>Small ruminant characterization in CWANA region</td>
</tr>
</tbody>
</table>
Summary of Livestock Biotech. In WANA region

- Biotechnology could support solving constraints of Livestock production and health.

- The development of biotechnologies for
  - Animal breeding,
  - Reproduction and
  - Molecular genetics

  - advanced markedly and
  - have the potential to increase reproductive efficiency and health of AnGRs.

- Advances: Artificial insemination, In vitro fertilization, Sexing embryos & multiple ovulation followed by embryo transfer (MOET)

  - have already had a major impact on livestock improvement in developed countries,
  - which can be directly adopted for developing countries such as WANA region.

- In developing countries, biotechnological applications to livestock need to be
  - suitable for animal owners who are resource-poor
1. Develop a critical mass in terms of human resources and laboratory facilities

2. Strengthen Biotechnology and biosafety research capabilities

3. Strengthen international, North-South and South-South collaboration

4. Establish a **regional platform** for sharing experiences, expertise and know-how to harmonise laboratory procedures, standards, and techniques of all biotechnology methodologies including GMO detection

5. Train relevant officers and technicians at the national level, and develop a **platform for information sharing** and networking amongst laboratory technical staff in biotechnology and GMOs detection.
The Way Forward and Next Steps (cont.)


7. Providing support for capacity building in agricultural biotechnology addressing in particular GMOs production and their risks assessment.

8. Establishing appropriate infrastructure to support biotechnology research.
A new vision for Agriculture in the Region?

Need a genuine Debate

- What should our agriculture look like?
- At one extreme – GMOs !!!!
- At the other – Organic !!!!
- How to map these differing philosophies onto the landscape????
Concluding Remarks

Biotechnology could support solving constraints of agricultural production in the Region; but requires high investments and should therefore:

- complement existing conventional technologies,
- be demand-driven,
- used only when it offers a comparative advantage;

Priority setting should involve all stakeholders and consider development policies and market opportunities.

Identification of needs

We have to make use of ALL options to increase food production in a sustainable way, including tissue culture and genetic engineering!

We have to evaluate the consequences of ALL our decisions, including the worst case that we do not apply genetic engineering /NGO-accountability/.

Priority of Enabling Environment for Investment in Agricultural Biotechnology in the region (Policy and investment environment, Strong collaboration between public and private sectors, target products, marketing....

Ethical Issues related to Use of GMOs, Risk assessment, Regulation, Communication are to be considered.

The technology may lead to changes in consumer behaviour and impact cultural and religious traditions.
1. Over the years, AARINENA has supported National Agricultural Research systems (NARS) in the region in capacity building through training programs, organizing technical and Scientific workshops and conferences, and establishing Regional Information and Communication System through active support and active participation of GFAR, ICARDA and FAO.

2. AARINENA has also contributed in establishing networks for essential crops in the region such as Date Palm, Cotton, Olive and Medicinal & Aromatic plants, and WUE Network.

3. AARINENA acted as a facilitator in bringing the views, aspirations and research priorities of the WANA region to the attention of the relevant international organizations with the aim of promotion of sustainable agricultural development.

FINAL CONCLUSION
Questions??
Thank you for your attention

شكراً لحسن استماعكم