Development of Sustainable Date Palm Production Systems in Gulf Cooperation Council Countries

Update on research in progress in Kingdom of Bahrain, State of Kuwait, Sultanate of Oman, State of Qatar, Kingdom of Saudi Arabia and State of the United Arab Emirates (2007-2010).
Acknowledgments


Key words:
Date palm production; Crop Management; Integrated Pest Management; Biodiversity and germplasm conservation; Post-harvest techniques; Red Palm Weevil; Lesser Date Moth; Dubas; borers; problem solving research; technology transfer; capacity building; irrigation systems; chemical and organic fertilization; packaging; liquid pollination; DNA extraction; fingerprinting; citric acid; fruit thinning; organic farming; natural enemies; drying methods; marketing; primer combinations; Kingdom of Bahrain; State of Kuwait; Sultanate of Oman; State of Qatar; Kingdom of Saudi Arabia; State of the United Arab Emirates; GCC countries; Arab Peninsula; ICARDA; International Center for Agricultural Research in the Dry Areas.

International Center for Agricultural Research in the Dry Areas (ICARDA)
P.O. Box 5466, Aleppo, Syria.
Tel: (963-21) 2213433
Fax: (963-21) 2213490
E-mail: ICARDA@cgiar.org
Website: www.icarda.org

The views expressed are those of the authors, and not necessarily those of ICARDA. Where trade names are used, it does not imply endorsement of, or discrimination against, any product by the Center. Maps have been used to support research data, and are not intended to show political boundaries.

Copyright © 2011 ICARDA (International Center for Agricultural Research in the Dry Areas)
All rights reserved.

ICARDA encourages fair use, sharing and distribution of this information for non-commercial purposes, with proper attribution and citation.
Table of Contents

Executive Summary

1. Introduction
   1.1 Background and context
   1.2 Project overview
   1.3 Workplan 2007-2010

2. Project achievements by country 2007-2010
   2.1 Problem solving research
   2.2 Technology transfer

3. Project achievements by research theme 2007-2010

4. Summary of achievements – other topics and activities
   4.1 Technology transfer and knowledge sharing activities
   4.2 Capacity Building

5. Constraints and Actions

6. Workplan Year 2011-2012

7. Annexes
   Annex 1    Publications
   Annex 2    Training Courses and Workshops
   Annex 3    Activities by Country
   Annex 4    Research Activities
   Annex 5    Meetings
Executive Summary

Developing Sustainable Date Palm Production Systems in the Gulf Cooperation Council Countries.
Report of activities and achievements, 2007-2010

The purpose of this report is to update partners and stakeholders involved on the achievements and progress to date of the project: Development of Sustainable Date Palm Production Systems in the Gulf Cooperation Council Countries.
The Date Palm project is a partnership between ICARDA – the International Center for Agricultural Research in the Dry Areas – and the Kingdom of Bahrain, State of Kuwait, Sultanate of Oman, State of Qatar, Kingdom of Saudi Arabia and State of the United Arab Emirates.

This research and development project aims to produce new knowledge and practices to improve the production systems for date palm in the Gulf region. This work includes improving cultivars productivity, managing natural resources (land and water) for optimal performance; use of different inputs in the cropping process (fertilizers, pollinators, wastewater, etc.), and the study of genetic diversity of date palm. The transfer of technology and experience between the partners is an integral part of the project.

Overview of activities 2007-2010

<table>
<thead>
<tr>
<th>Project Component</th>
<th>Focal Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bahrain</td>
</tr>
<tr>
<td>1. Crop management</td>
<td>✓</td>
</tr>
<tr>
<td>2. Integrated pest management</td>
<td>✓</td>
</tr>
<tr>
<td>3. Post-harvest techniques</td>
<td></td>
</tr>
<tr>
<td>4. Biodiversity conservation</td>
<td>✓</td>
</tr>
</tbody>
</table>

Summary of achievements – 2007-2010

**Crop management:** researchers in the project’s crop management component found that that fruit thinning and using sewage water through bubblers gave better yield and fruit quality. These results are being transferred to the other Gulf Countries. **Crop protection and integrated pest management:** these researchers identified two pesticides, effective in reducing fruit infestation and identified natural enemies of Lesser Date Moth; more than 305 date palm pests which belong to twenty-two orders were identified through faunal survey and their predators, belonging to seventeen species, were documented as a biological pest infestation control measure. Scientists studying **post-harvest techniques** concluded that drying fruit in locally-made glass chambers reduced the period of drying from 12 to 5 days; the production of added value ingredient such as citric acid from non-marketable dates by using modern techniques was investigated. Studies were done of consumer preferences for date palm packaging. **Biotechnology conservation:** facilities for genomic analyses and DNA extraction were established in all countries; fingerprinting of date palm cultivars was done to determine their genetic diversity level. A bulletin on harvesting and post-harvest handling of dates was prepared and distributed in Arabic and English; Publications resulted from the work to date (see list in Annex 1); 85 researchers were trained in different fields (Annex 2); various processes methods were tested and documented.

Research partners also identified a number of constraints. These include: a need for more training courses with content that better fits the skill level of participants and for better training infrastructure in some countries. An adequate budget and a smooth payment schedule is a need not always met due to the delay in receiving allocated budget as a result of country regulations. The slow response in both, dealing with project requirements such as publications and progress reports as well as in dealing with limited budget and slow budget transfer was found to be a hindrance to the development of the project.

Recommendations emerging from the research look at the production of citric acid and the added value of other by-products from blemished, fallen, surplus or low quality dates.

Next steps

The project team felt that the project’s achievements to date, coupled with the interest of the national agricultural research systems involved and the GCC countries, make a case for the project to continue its work and receive further funding to encourage improved production of date palm in the region, quantitatively and qualitatively. Due to the significance of date palm as major crop in the GCC countries, an increased capacity building of partners in the participating countries is needed to realize its sustainable development.

*The work plan for 2011-2012 is included in section 6 of this report*
1. Introduction

1.1 Background and context

The date palm tree tolerates relatively harsh climatic and soil conditions under which no other crop will give reasonable returns. It is an irreplaceable tree in irrigable desert lands, providing protection to under-crops from heat, wind and other threats and plays a big role in combating desertification.

Date palm offers countries a practical solution to improve food security and rural livelihoods. It is a good food source of high nutritive value that offers date-growing countries in the Gulf Cooperation Council (GCC) a stable food source for their populations. Date palm also provides work opportunities to a considerable numbers of farm laborers.

Today, the date palm industry is facing serious problems. These include low yields, a lack of appropriate packing and presentation, limited production of sound industrial date products, a lack of technological know-how, and threats from pests such as Lesser Date Moth, Red Palm Weevil, dust mites, borers, Dubas, etc.

To address these issues and set priorities for research and development, the Gulf Cooperation Council countries joined the Consultative Group on International Agricultural Research (CGIAR) in 2003, and assigned the International Center for Agricultural Research in the Dry Areas (ICARDA) to facilitate a research initiative on date palm in the National Agricultural Research Systems, (NARS) of the participating countries.\(^1\)

1.2 Project overview

The project on Development of Sustainable Date Palm Production Systems in the Gulf Cooperation Council Countries resulting from this partnership was created in 2004.

Box 1. Project components and research themes

<table>
<thead>
<tr>
<th>Project Component</th>
<th>Focal Area</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Research Themes</strong></td>
<td></td>
</tr>
</tbody>
</table>
| 1. Problem-solving research | • Propagation and Crop Management  
 • Crop protection and integrated pest management  
 • Post-harvest handling and processing techniques, marketing and processing  
 • Biotechnology and germplasm conservation |
| 2. Technology transfer | Transfer and adoption of suitable technologies developed regionally and/or internationally |
| 3. Capacity building | Strengthening national agricultural research systems (NARS) and providing specialized training for national research staff, extension agents and farmers in the participating countries |
| 4. Technology and expert systems | Technology and expert systems to develop a date palm expert system |

---

\(^1\) As a first step towards project initiation, (ICARDA) conducted a regional workshop on date palm development in Abu Dhabi, on 29-31 May, 2004 involving researchers and scientists from (GCC) countries, international experts and organizations. In this meeting, a five-year plan for date palm project proposal on the development of sustainable date palm production systems in the Arabian Peninsula was elaborated to serve six Gulf countries including Kingdom of Bahrain, State of Kuwait, Sultanate of Oman, State of Qatar, Kingdom of Saudi Arabia and State of the United Arab Emirates.
1.3 Workplan 2007-2010:

The date palm research project has 58 activities, see (Table 1) and (Annex 3 & 4)

| Table 1: Number of date palm research activities approved among listed (GCC) countries |
|----------------------------------|---|---|---|---|---|---|---|
| Research Area                    | Bahrain | KSA | Kuwait | Qatar | UAE | Oman | Total |
| 1. Crop management               | 2       | 2   | 6      | 2     | 2   | 9    | 23    |
| 2. Integrated pest management    | 1       | 3   | 1      | 1     | 1   | 2    | 9     |
| 3. Post-harvest techniques       | 0       | 1   | 1      | 1     | 3   | 1    | 7     |
| 4. Biotechnology                 | 1       | 1   | 1      | 3     | 1   | 2    | 9     |
| Sub Total                        | 4       | 7   | 9      | 7     | 7   | 14   | 48    |

2. Project achievements by country 2007-2010

2.1 Problem solving research

Kingdom of Bahrain

1. **Crop Management**: The effect of chemical and organic fertilizers on the production and growth of date palm is under investigation, and the use of liquid pollination for the improvement of the date palm yield and quality was effective. Further on-farm verification is under progress.

2. **Integrated Pest Management**: More than 305 date palm pests, which belong to 22 orders, were identified through faunal survey and their predators which belong to seventeen species were documented as a biological pest infestation control measure.

3. **Biodiversity and germplasm conservation**: Facilities for genomic studies were also established.

Kingdom of Saudi Arabia

1. **Crop Management**: Three male pollinators with excellent pollen viability and germination, together with their contribution to the yield enhancement have been identified. On the other hand, pre-harvest withholding of irrigation was ineffective on skin separation of the fruit.

2. **Integrated Pest Management**: A survey detected two dust mite species and their control measure. Using pesticide- Biacao No.1 (0.36% Matrine) proved effective; several predators to control Lesser Date Moth (LDM) as a biological control measure were identified; in addition, biopesticide (Spinosad) was studied and was also effective against the control of LDM.

3. **Post-harvest handling and processing techniques**: Research identified new, more suitable packaging containers for date fruits, determined their optimum storage conditions for maximum efficiency, and ranked their acceptance by date consumers.

4. **Biodiversity Conservation**: Important local cultivars of date palm were characterized and their DNA fingerprint data was established.

Kuwait

1. **Crop Management**: Bubbler irrigation systems with treated sewage water was effective in enhancing the yield and fruit quality of date palm; studies on the effect of irrigation schedule and mulching, as well as fertilizer usage are under progress.

2. **Integrated Pest Management**: Several pest species and their predators were identified; two bio-pesticides namely Kingbo and Agri2000 were effective in controlling infestation by borers and mites.
3. **Post-harvest handling and processing techniques**: Researchers identified new and more suitable packaging containers for date fruits, determined their optimum storage conditions for maximum efficiency, and ranked their acceptance by date consumers.

4. **Biodiversity Conservation**: Important local cultivars of dates were characterized and their DNA fingerprint data was established.

**Qatar**

1. **Crop Management**: Fruit thinning to improve ventilation proved to be very effective; but on-farm testing is still under progress; studies on irrigation schedule is under way.

2. **Post-harvest handling and processing techniques**: Using locally made glass chambers, equipped with shelves and ventilation, was effective for drying dates in shorter periods, (5 days only, vs. 12 days under plastic tunnels, or 14-18 days for direct sun drying) and for reducing skin separation. Date fruits dried in this chamber were much cleaner.

3. **Biodiversity Conservation**: Genetic diversity focused on the study of 12 local cultivars, established DNA markers identified to detect the male date palms; newly designed SSR markers developed by (ICARDA) were verified and their efficiency in genetic characterization was confirmed.

**United Arab Emirates**

1. **Crop Management**: Water requirements for date palm production are under investigation.

2. **Post-harvest handling and processing techniques**: Two bio-pesticides were effective in controlling infestation by borers and mites, verification in other (GCC) countries is under way; Bio-pesticide: Baicao No.1 (0.36% Matrine) succeeded in controlling dust mite infestation.

3. **Post-harvest handling and processing techniques**: Using a glasshouse to reduce the period of fruit drying and improve the fruit quality was effective; technology is being transferred to growers; Tamar stage of fruit harvesting yielded high quality fruits with reduced skin separation.

4. **Biodiversity Conservation**: Important local cultivars of dates were identified and their DNA was extracted for genetic characterization and DNA fingerprinting.

**Sultanate of Oman**

1. **Crop Management**: Studies on the effect of the source of pollen grain on fruit set indicated that sources of Ghareef and Khoori, were effective on the fruit set of Zabad cultivar, and that pollen source of Bahlani was effective in enhancing the fruit weight. The application of Boron was ineffective in enhancing the fruit set. Significant effects of pre-harvest application of Ethephone on fruit ripening, shrinking and falling in Nighal cultivar were identified, and their on-farm testing is still under progress.

2. **Integrated Pest Management**: Two pesticides, Trebon®20%EC and Kingbo® 0.6%SL were effective in reducing fruit infestation. Some natural enemies to control LDM infestation were identified; and a survey for additional natural enemies of LDM is in progress.

3. **Post-harvest handling and processing techniques**: The possibility of the production of citric acid from date fruit was demonstrated by applying submerged techniques.

4. **Biodiversity Conservation**: Date palm genotypes of Saudi Arabia, Kuwait, Bahrain, and Oman were investigated using SSR markers, and the percentage of their genetic diversity was...
established; tissue culture derived from these genotypes was uniform at the genetic level using SSR marker analysis, (Annex 3 and 4)

2.2 Technology transfer

1. The strategy on the control of red palm weevil was elaborated in the international meeting on Red Palm Weevil Control Strategy held in Elche, Spain in April 23-24, 2007 and it was dispatched to the (NARS) of participating (GCC) countries
2. Arabic and English versions of a bulletin containing the latest developments and accumulated knowledge on post-harvest handling techniques published by (ICARDA) were distributed among the six countries. Other pertinent publications in this field were purchased from University of California-Davis and distributed among the involved (NARS)
3. Four thematic meetings were conducted to share the results of date palm project among the (NARS) of the participating (GCC) countries
4. Effective techniques identified in the date palm project are being transferred to the growers' field.

3. Project achievements by research theme 2007-2010

<table>
<thead>
<tr>
<th>Research Area</th>
<th>Bahrain</th>
<th>KSA</th>
<th>Kuwait</th>
<th>Qatar</th>
<th>UAE</th>
<th>Oman</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Propagation and Crop management</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td>2. Crop protection and Integrated pest management</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>3. Post-harvest handling and processing techniques</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>4. Biotechnology and germplasm conservation</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>Sub Total</td>
<td>4</td>
<td>7</td>
<td>9</td>
<td>6</td>
<td>7</td>
<td>12</td>
<td>45</td>
</tr>
</tbody>
</table>

Theme 1: Propagation and Crop Management

Out of 23 research activities carried out in three (GCC) countries, progress was made for 21 activities, and key results were generated under the thematic area of propagation and crop management of date palm research, See (Table 4).

Out of 13 techniques analyzed, ten were found effective; one was ineffective in improving the date palm productivity. Effective techniques were transferred to the growers' field and the (NARS) of the (GCC) counties involved. The ineffective technique for the yield improvement was suspended. Some of the research activities are still under investigation and the results are yet to be generated. The key conclusions generated are:

1. Use of bubbler seems to be the best irrigation system for the date palm production
2. Withholding irrigation before harvest is not related to skin separation of the fruit
3. The effectiveness of thinning, liquid pollination and use of rings to improve ventilation was proven very effective and results are being transferred to growers
4. On-farm verification of the effect of source pollen grains on fruit set is underway
5. On-farm verification of the effect of pre-harvest application of Ethrel on fruit ripening and quality is underway
6. The best extraction method, drying method and storage conditions giving the highest pollen viability and germination percentage were obtained and will be transferred to the (NARS) of all (GCC) countries concerned
7. Water and fertilizer needs are still under investigation
8. Evaluation and selection of male pollinators and mulching experiments are still under investigation
9. The effect of Boron on fruit set proved ineffective and the experiments were suspended.

**Theme 2: Crop protection and integrated pest management (IPM)**

Progress was made in eight out of the nine undertaken activities. Crop protection and integrated pest management research activities focused on identifying the major pests of date palm fruit infestation, as well as on their natural enemies, if any, and on identifying suitable control measures using insecticides and pesticides, with the special focus on major pests such as: Lesser Date Moth (LDM), dust mites and borers. Pest control methods which are found effective were further tested in the growers’ field and the (NARS) of the (GCC) counties involved. Survey process identified a few natural LDM enemies and more natural enemies are being investigated. The key information generated is as follows:

1. Survey results indicated more than 305 pest species representing 22 genera in Bahrain, Kuwait and KSA
2. Out of three pesticides tested, Trebon*20%EC and Kingbo® 0.6%SL were effective against the major pest -Lesser Date Moth (LDM)- in reducing fruit infestation
3. Seventeen natural enemies - predators representing five orders for the control of LDM- were identified and are being evaluated
4. Survey for additional natural enemies of LDM is underway
5. Bio-pesticide –Spinosad was very effective against the earlier known predators of LDM pest. This would be further tested in other partner countries
6. Two bio-pesticides were effective against the infestation of borers and mites but they need further verification in the other (GCC) countries
7. Bio-pesticide “Baicao No.1 (0.36% Matrine)” provided a good level of control against dust mites
8. Conventional insecticide “Nirone” was effective in controlling dust mites.

**Theme 3: Post-harvest handling and processing techniques**

Progress was made in all seven research activities. The key activities focused on identifying suitable drying methods, packaging materials, storage conditions and the production of citric acid from dates - a value-added product. The techniques which were effective were further tested in the growers’ field and at the (NARS) of the (GCC) counties involved. The following key results were generated under the thematic area of post-harvest handling and processing techniques:

1. Using small glasshouses, with a capacity of 18 tons per season in UAE proved effective; and the Ministry of Environment and Water subsidized 50% of total cost for the establishment of 78 units throughout the countries in 2009 and 20 units in 2010
2. In Qatar, using locally made, cheaper plastic tunnels (Mustah) with shelves and ventilation were not only cheaper than conventional methods, but also more efficient in shortening the drying period, protecting the fruits from infestation and deterioration, and reducing skin separation. This method is being further improved before its release to growers
3. Determining optimum temperature and relative humidity during date-drying process under plastic and glass houses conditions is being investigated
4. Identifying the best packaging containers and storage conditions for important cultivars is still underway but some preliminary results were obtained concerning the size of the container, its nature and level of acceptance by both, the packing houses and the consumers.

5. Using the submerged technique for the production of citric acid from dates provided better results in reducing the fermentation period compared to the surface technique.

**Theme 4: Biotechnology and germplasm conservation**

Nine out of nine activities under thematic area of biotechnology and germplasm conservation in date palm research were completed. The key activities focused on establishing DNA fingerprint dataset for the local cultivars of date palm and the assessment of their genetic diversity. Facilities for genomic studies were either established or upgraded in a few (GCC) countries. The key information generated includes:

1. A set of eighteen, simple sequence repeat (SSR) markers was screened among 24 genotypes belonging to four (GCC) countries, namely Saudi Arabia, Kuwait, Bahrain and Oman. A total of 610 alleles were identified with an average of 29 alleles per locus (range of 13-32 alleles) and their polymorphism information content (PIC) value was 0.88 (0.81-0.93)
2. Facilities were established and/or upgraded in Saudi Arabia and Qatar
3. Facilities for DNA extraction were established in Kuwait, Bahrain and UAE
4. A set of 12 samples of tissue culture derived plants of Khalas a’ Dhahra variety, along with their female parent, were analyzed with 20 (SSR) markers to identify the polymorphism among the test samples, and no polymorphism was detected
5. In collaboration with Cornell University, (ICARDA) developed a set of 1000 SSR markers. Thirty markers were tested for their efficiency to amplify local date palm cultivars and found to be polymorphic as well as co-dominant, which can be used for the genetic diversity analysis of date palm
6. Optimizing methods to reduce cost, time and effort for samples analysis is underway (Annex4).

**4. Summary of achievements – other topics and activities**

**4.1 Technology transfer and knowledge sharing activities**

**Strategy for control of Red Palm Weevil**

The strategy for the control of the Red Palm weevil that was elaborated by an international Panel, including the date palm coordinator and scientists from (GCC) countries at Elche Spain in 2007 was sent to the involved (NARS) of the involved countries.

**Transfer of most recent knowledge and practices on post-harvest handling and processing techniques of dates used in the USA**

Following the workshop on palm date post-harvest handling and processing held in Dubai in December 2007, it was concluded that 90% of date post-harvest problems can be overcome by the utilization of existing technologies. The Arabic and English versions of a bulletin containing the latest developments and accumulated knowledge was elaborated in collaboration with the University of California-Davis, published by (ICARDA) and distributed among the six countries. Other pertinent publications in this field were also purchased from University of California-Davis and distributed among the involved (NARS).
Transfer of techniques tested in date palm research to growers' field

Technology on date drying in small glasshouses was transferred to growers’ fields in the UAE

Techniques such as liquid pollination, fruit drying in plastic houses, the application of Ethrel on thinning and those related to the best harvesting stage for improved drying and identifying the effective pesticides and bio-pesticides are ready to be transferred to growers.

Thematic Meetings

Four thematic meetings were organized to promote the sharing of results, ideas and experience between the scientists and NARS representatives in the participating countries.

1. **Post-harvest techniques**’ meeting was held in Ras Al-Khaima, UAE, in the period of 15-16 March, 2009. The meeting was attended by 11 scientists and two international experts
2. **Integrated Pest Management** meeting in Manama, Kingdom of Bahrain, was held in the period of 22-26 March, 2009. The meeting was attended by 14 scientists and four international experts
3. **Crop management meeting** in Kuwait city, State of Kuwait, was held in the period of 12–13 April, 2009. The meeting was attended by 17 scientists and one expert
4. **Biotechnology meeting** was held in Rumais, Sultanate of Oman on 11 May, 2009. The meeting was attended by 13 scientists and four international experts. The reports of each meeting are in (Annex 5).

4.1 **Capacity Building**

ICARDA gave a number of training courses and workshops to researchers involved in the project to enhance their technical skills. These sessions were supported by the Date Palm Project Fund. The project team also encouraged scientists from participating countries to attend conferences to present their work.

A number of manuals and publications were prepared or provided to partners. The project coordinator attended several meetings and conferences to gather and update information on date palm research, and he published several reports.

5. **Constraints and Actions**

The date palm research project is facing some issues which slow down the success rate of the project. The list of bottlenecks and their possible solutions are described as follows:

1. Insufficient skilled human resources: Number of skilled national research staff is not enough to carry out diverse as well as sophisticated research activities. In addition, the present researchers require more training and upgrading in research techniques, experimental design, statistical result analyses, etc
2. Slow response in dealing with project requirements such as publications, progress reports, and even sending trainees on training courses
3. Limited budget and slow budget transfer: The availability of some modern and essential research tools and the increased needs for extensive training, workshops and participation in other scientific meetings require sufficient budget and smooth payment schedule. Furthermore, thematic and similar experience exchange cannot take place without adequate allocated budget
4. Due to some country regulations, the allocated budget wiring cannot be received by the beneficiaries timely.
Action is required to quantitatively and qualitatively support the NARS through increasing the project working staff and catching up with modern technology extensively. It is equally required to increase the funding to respond to the essential requirements of the ongoing and planned research as well as the human capacity building which is considered vital for the success of the project.

6. Workplan 2011-2012

To accomplish the project objectives, activities of research, technology transfer and capacity building components will continue in 2011-2012. The number of research activities to be moved forward under four thematic areas in all (GCC) countries is summarized in (Table 5). The total of 46 research activities will further increase.

Table 5: Number of research activities carried forward for the year 2011-2012

<table>
<thead>
<tr>
<th>Research Area</th>
<th>Bahrain</th>
<th>KSA</th>
<th>Kuwait</th>
<th>Qatar</th>
<th>UAE</th>
<th>Oman</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Crop management</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>19</td>
</tr>
<tr>
<td>2. Integrated pest management</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>3. Post-harvest</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>4. Biotechnology</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td><strong>Sub Total</strong></td>
<td><strong>4</strong></td>
<td><strong>7</strong></td>
<td><strong>8</strong></td>
<td><strong>8</strong></td>
<td><strong>7</strong></td>
<td><strong>11</strong></td>
<td><strong>46</strong></td>
</tr>
</tbody>
</table>
IPM and Plant Protection
Light traps used to assess the importance and distribution of the insect and determine the number of its generations

IPM and Plant Protection
Different fauna identified and natural enemies found for optimum pest control

Biotechnology
Separating DNA using Gel electrophoresis system

Post-harvest techniques
Ventilated glass chambers with shelves produce much cleaner fruits and cut down date drying period from 14-18 days, to only five days

Crop Management
Experimenting with different sources of chemical fertilizers to determine their effect on growth and yield

Crop Management
Drying pollen in thermal chambers is one of the major crop management activities
Annex 1

Publications

**Saudi Arabia**

1. Study of the Genetic finger print of 25 important Cultivars in KSA, (Hassan Bou Oweis, Khaled Bou Jleia; Hajji Ashour)
2. Study of the pre harvest water holding on the fruit scaling, (Nasser Salem Al Ghanem; Nabil Abdul Rahman Boudi; Shaheen Hamad Al Shaheeen; Saoud Al Saoud)
3. Survey Study on the Date packages in KSA and the receiving by the consumers, (Mohammad Abdul Rahman Al Ghannam; Mohammad Ahmad Alajamal; Radhi Hassan Al Amer; Fakhry Abdullah Al Shareed; Khaled Bou Jleia)
4. Field Survey of Dust Mite Species in Al Ahssa, (Abdullah Ali Al Shaqqaq; Salim Mohammad Al Bather; Mansour Mohammad Al Baqshi; Sammi Ahmad Al Sarroudj; Abdel Mounem Ali Al Shawwaf; Abdel Mounem Al Dandan)
5. Assessment and selection of some Pollinator in Al Ahssa region and Study their effect on the productivity and quality of the fruits, (Ahmad Abdul Aziz Al Amraan; Mohammad Saad Al Housseini; Nabil Mohammad Al Wosseibaii; Hajji Houssein Al Ashour; Hajji Ali Al Hajji)

*These publications available in Arabic only*

**Sultanate of Oman**

1. Development of genomic tools for germplasm characterization in date palm
2. Assessment of abnormalities found in the tissue culture derived date palms.
3. Studies on the Effect of Source of Pollen grains on Fruit set of Zabat Cultivar
   - Said al-Sabahi; Naser Al-Abri; Sulaiman Al-Amri; Salim Al-Humami; Mahmmmod Al-Rashdi;
   - Hamad Al-Dhuhi; Mohamed Al-Hinaai; Mr. Ibrahim Al-Busaidi
4. Effect of ‘Boron” foliar application on fruit set of Zabad cultivar
5. Effect of pre-harvest application of Ethrel on ripening and quality of Nighal dates
6. Study on effect of fruit thinning of Khalas Date Palm cultivar on fruit drop, ripening time, yield and dates quality.
7. Effect of pre-harvest application of Ethrel on Khalas Al-dahra dates ripening and quality
8. Effect of mulching with pruning leaves of date palm on irrigation water availability and date palm growth, yield and fruit quality.
9. Production of citric acid from dates (Mohammed Al-Abid; Mansorah Al-Amry; Fouziah Al-Rawahy).

**Qatar**

1. Survey of the important date palm pests in Qatar
2. Effect of fruit thinning on the growth and quality of Khalas variety of date palm, (Tareq Al Zidjali; Abdullah Abul Einein; Amer Faiyadh Al Kuheis)
3. Study of effect of different drying techniques on the fruit scaling in Khalas Cultivar, (Tareq Al Zidjali; Abdullah Abul Einein; Amer Faiyadh Al Kuheis)

*These publications available in Arabic only*
UAE
1. Study of the drying techniques and storage on the pollen viability and percentage of sprouting of (Phoenix dactyl) in Al Hamraniyeh Research Station, (Amer Mohammad Bandar Al Aan; Saeed Hassan Al Bagham; Mansour Ibrahim Mansour; Saleh Abdullah Akrouit; Walid Mohammad Al Safadi)
2. Comparison study of the drying by the solar energy through the glass and plastic drying chamber, and the thermal chamber, (Amer Mohammad Bandar Al Aan; Saeed Hassan Al Bagham; Mansour Ibrahim Mansour; Saleh Abdullah Akrouit)
3. Identifying the best maturity stage of Lulu, Barhi and Khalas for Drying and Marketing, (Amer Mohammad Bandar Al Aan; Saeed Hassan Al Bagham; Mansour Ibrahim Mansour; Saleh Abdullah Akrouit)
4. Feasibility study of different dates drying techniques with regards to economic feasibility, production capacity and operational cost, (Amer Mohammad Bandar Al Aan; Saeed Hassan Al Bagham; Mansour Ibrahim Mansour)

These publications available in Arabic only

Kuwait
1. Crop Management trial on irrigation related research and fertilization research, (Abdul Khaleq Abdul Ghaffar; Mohammad Awad Al Harbi; Abdul Daiem Abdul Raouf; Abdul Nabi Rashed Al Shirazi; Mahdi Ibrahim Al Qallaf)
2. Effect of harvesting and methods of packaging and storage on post‐harvest losses; (Ahlaam Ibrahim Al Shareedah; Nasser Yaqoub; Abdul Daiem Abdul Raouf, Hussein Al Qallaf, Mahdi Al Qallaf)

These publications available in Arabic only

Bahrain
1. Study of the effect of fertilization by Organic and chemical fertilizer on the productivity of Khalas Cultivar; (Ahmad Adam Ahmad Al Saffi; Sadeq Eissa Mansour; Abdul Aziz Mohammad)
2. Study on the effect of liquid pollination on the quantity and quality of Khalas cultivars, (Sadeq Eissa Mansour; Ahmad Al Saffi; Abdul Aziz Mohammad Abdul Karim)

These publications available in Arabic only

English Publication
1. Faunal Survey of Insects and Mites Associated with Date Palm in Kingdom of Bahrain (Abdul Aziz M.A. Mohamed; Ali Ahmed Elesfoor; Isa Ahmed Ghanim)

Posters
1. Development of Sustainable Date Palm Production Systems in the GCC Countries (Activities on Post‐harvest)
2. Development of Sustainable Date Palm Production Systems in the GCC Countries (Activities on Biotechnology)
3. Development of Sustainable Date Palm Production Systems in the GCC Countries (Activities on Crop Management)

15
4. Development of Sustainable Date Palm Production Systems in the GCC Countries (Activities on Integrated Pest Management and Plant Protection)

Annex 2

A2.1 Training Courses and Workshops conducted by (ICARDA)

1. A specialized training course on DNA Marker Technology for Crop Improvement was held in Muscat, Oman in the period of November 18-30, 2005. It was organized in collaboration with the Ministry of Agriculture-Sultanate of Oman. Four international experts were involved in this training program and 18 scientists of (GCC) countries have benefited from it.

2. A training course on Date palm in-vitro culture: Applications and Prospects was conducted at the date palm research center, Nizwa, Sultanate of Oman in the period of May 26-30, 2007. Two experts were involved in this training course and a total of 17 scientists from (GCC) countries were duly trained.

3. Following the recommendations of the third Steering Committee meeting of this project, a workshop on Date post-harvest handling and Processing was conducted in Dubai, UAE in the period of December 9-11, 2007 in collaboration with the Ministry of Environment and Water (MoEW) of the United Arab Emirates. Four international experts were involved in this workshop and 14 scientists of (GCC) countries were trained in this area.

4. A workshop on Date Palm Integrated Pest Management was organized in collaboration with the Ministry of Municipalities Affairs and Agriculture, was held at Manama, Kingdom of Bahrain in the period of March 24 – 26, 2009. With the support of seven international experts, 14 scientists of (GCC) countries were trained in this area.

5. Advanced biotechnology course with statistical analysis was organized in collaboration with the Ministry of Agriculture, Muscat, and Sultanate of Oman in the period of May 9-13, 2009. Seven international experts were involved in this course with the participation of 17 scientists of (GCC) countries.

6. On the basis of requisition by Ministry of Agriculture, Afghanistan and the kind approval of the Ministry of Agriculture of Oman, a specialized short course on date palm was organized for four Afghani scientists in collaboration with the Ministry of Agriculture of the Sultanate of Oman in the period of 12-17 June 2009.

7. One technician from biotechnology laboratory in Oman was supported to undergo a training session on Latest developments in the genomic research areas of date palm and the DNA markers used for date palm characterization in the biotechnology laboratories of (ICARDA), Aleppo.

8. Two scientists from Kuwait were sent on a training course in biotechnology in Oman, in the period of March 25 till April 4, 2010.

A2.2 Conference and Symposium sponsorship

1. Three scientists were supported to participate in the international workshop on Red Palm Weevil Control Strategy held in Elche, Spain in the period of April 23-24, 2007.

2. Six scientists of (GCC) countries were supported to participate in the 4th symposium on date palm: Challenges of processing, Marketing and Pests control, held at date palm research center, King Faisal University, Kingdom of Saudi Arabia in the period of May 5-8, 2007.

3. Sponsor of three scientists to participate in the 4th International Conference on Date palm in Abu Dhabi, March 2010.
A2.3 Visits of Project Coordinator

1. Date palm project coordinator visited California and Arizona to update the latest developments in date palm cultivation and post-harvest handling and processing of dates in the period of January 11-19, 2009
2. The coordinator of the date palm Project, together with one scientist from Oman participated in the Symposium on Red Palm Weevil held in Italy in May 15-17, 2010
3. To monitor the implementation of the recommendations made by Steering Committee meetings of date palm project among the concerned (NARS), and to assess the progress of research activities, the project coordinator visited these centers several times in 2007-2010
4. The coordinator of the date palm project dispensed several conferences and published a number of papers.

A2.4 Consultancy Services

Upon invitation of the Arab Authority for Agricultural investment and Development and the kind approval of the Director General of (ICARDA), three consultancy missions were carried out for the Comoros to recommend the improvement of tissue culture laboratory, acquiring the necessary equipment and supplies and offering suitable training for the technicians. Similar support was also extended to Sudan.

Annex 3

Activities by Country (2007-2010)

Kingdom of Bahrain

Bahrain is the leading country for the research theme of crop protection and integrated pest management. Four research activities were set in the areas of crop management, crop protection and IPM and biotechnology:

1. The area of crop management seeks to study the effect of chemical and organic fertilizers on date palm growth and production and the effect of liquid pollination on date palm quality and quantity
2. The area of crop protection and IPM focuses on the faunal study of the insects and pests of date palm
3. The area of biotechnology focuses on the development of the genomic tools for germplasm characterization and genetic diversity of local date palm varieties.

Kingdom of Saudi Arabia

Saudi Arabia is the second leading country for the research theme of crop protection and integrated pest management. Seven research activities were set in the areas of crop management, crop protection and IPM, post-harvest techniques and biodiversity conservation:

1. Crop management seeks to evaluate male pollinators, and study the effect of pre-harvest holding of irrigation on date palm fruit cracking
2. Crop protection and IPM seeks to assess the level of infestation of dust mite, its control measures and the level of infestation of Lesser Date Moth
3. Post-harvest techniques are seeks to study the effect of packaging containers of dates and their level of acceptance by the consumers
4. Biotechnology area seeks to fingerprint five local date palm cultivars.
Kuwait

Kuwait is the leading country for the research theme of crop management. A total of nine research activities were set in the areas of crop management, crop protection and IPM, post-harvest and the biotechnology as follows:

1. Crop management activities seek to study two areas of research: irrigation and fertilization. The irrigation component studies the effect of irrigation schedule and the kind of mulching on date palm growth, yield and fruit quality under water scarcity conditions; effect of three irrigation systems on the growth, yield and fruit quality, using treated sewage water and the effect of plastic mulching on weed control using drip irrigation. The fertilization component investigates the effect of fertilizer and its quantity effect of monthly applications of NPK fertilizers and effect of foliar applications of microelements on growth, yield and fruit quality

2. Crop protection and IPM activities study the pests and diseases of date palm through field surveys

3. Post-harvest handling and processing techniques study the effect of harvesting stage, packaging techniques and storage conditions on reducing the post-harvest losses

4. The area of biotechnology seeks to study in-vitro propagation and genetic diversity

Qatar

Qatar is the leading country in Biotechnology. Seven research activities were set in the areas of crop management, and biotechnology as follows:

1. Crop management focuses on the effect of fruit thinning on fruit quality and the response of date palm to irrigation with treated sewage water

2. Post-harvest handling and processing techniques area studies the effect of three different solar drying techniques on scaling of dates

3. Biotechnology activities seek to establish database on date palm research

United Arab Emirates

UAE is the leading country in post-harvest handling and processing techniques. A total of seven research activities were set in the areas of crop management, crop protection and integrated pest management, and post-harvest handling and processing techniques:

1. Crop management seeks to assess date palm water requirements using different irrigation systems and study the economic return and environmental effect of organic farming on date palm trees

2. Crop protection and IPM studies the efficacy of different pesticides on dust mite infestation

3. Post-harvest handling and processing techniques activities focus on the identification of best drying system using solar energy; best harvesting stage for improved drying and marketing of date palm cultivars and study the total cost, running cost and production capacity

4. Biotechnology aims to develop genomic tools for germplasm characterization.
Sultanate of Oman

Oman is the leading country in Biotechnology. Thirteen research activities were set in the areas of crop management, crop protection and IPM, post-harvest handling and processing techniques and biotechnology:

1. Crop management probes into the effect of pollen grains source; female receptivity period; effect of foliar application on fruit set; variations in fruit ripening due to climatic conditions and pre and post-harvest application of the growth regulator Ethrel (Ethephone); studies on improvement of yield and fruit quality of date palm through pollen grain source a fruit thinning and pre harvest application of Ethrel; effect of mulching with pruned leaves of date palm on irrigation water availability
2. Crop protection and IPM aims to study the efficacy of different pesticides against Lesser Date Moth and to survey pests’ natural enemies
3. Post-harvest handling and processing techniques focus on the production of citric acid from dates
4. Biotechnology seeks to develop genomic tools for germplasm characterization and assess the abnormalities found in tissue-culture derived date palms.

Overview of Research Program

A6.A: Propagation and crop management

This category of the research area aims to assess and adopt best agro-management practices for the date palm productivity, especially in the areas of tree propagation, irrigation, fertilization, head management (male selection, pollination, dethroning, fruiting, thinning, packaging, etc.) and mechanization of tree services with the aim to achieve the following objectives:

1. Improving date palm productivity per unit of water and rationalizing the use of the available water resources to ensure sustainability
2. Determining water and nutritional requirements for different irrigation systems, cultivars, environmental conditions, soil types, qualities of irrigation water (saline and sewage) and with different fertilizers
3. Improving date palm head practices and management for more productive trees with higher yield and better fruit quality at harvest
4. Developing a model for irrigation and fertilization practices.

A6.B: Crop protection and integrated Pest Management (IPM)

This category aims to identify suitable method(s) to protect date palm trees from pests and diseases in the selected regions of (GCC) countries involved. The objectives are:

1. Identifying major pests and diseases of date palm in selected regions of (GCC) countries
2. Identifying natural enemies for pest infestation biological-control measures
3. Identifying suitable and safe pesticides
4. Developing proper IPM programs to control the pests and diseases of date palms.
A6.C:  **Post-harvest handling and processing techniques**

In order to improve the marketing process in general and the quality of fruits in particular, this category has the following objectives:

1. To identify suitable post-harvest handling and processing techniques such as handling methods, packaging materials, storage conditions, transportation etc., as well as the processing methods of date fruits
2. Improve proper post-harvest handling and processing techniques such as handling, packaging, storage, transportation etc.
3. Develop new processing techniques for value-added date products and by-products.

A6.D:  **Biotechnology and germplasm conservation**

This category aims to establish DNA fingerprints of local date palm cultivars and genomic tools for germplasm characterization, and also to assess the existing level of genetic variability among the germplasm resource of (GCC) countries involved. The objectives are:

1. To identify, classify and DNA-fingerprint local date palm varieties
2. Develop genomic tools for germplasm characterization
3. Assess genetic diversity among date palm cultivars
4. Assess abnormalities found in the tissue culture derived from date palms
## Annex 4

### Research Activities carried out among (GCC) Countries during year 2007-2010

<table>
<thead>
<tr>
<th>Research Area</th>
<th>Activities undertaken</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Kingdom of Bahrain</td>
<td>1. The effect of chemical and organic fertilizer on date palm growth and production</td>
</tr>
<tr>
<td></td>
<td>2. The effect of liquid pollination on dates quality and quantity in the Kingdom of Bahrain</td>
</tr>
<tr>
<td>2. Kingdom of Saudi Arabia</td>
<td>1. Selection and evaluation of the male date palms used for pollination in Al-Ahsa oasis</td>
</tr>
<tr>
<td>3. State of Kuwait</td>
<td>1. Study of the effects of pre-harvest holding of irrigation water on date palm Khalas CV. fruit cracking</td>
</tr>
<tr>
<td>4. Biotechnology</td>
<td>1. Conduct survey and assess the infestation level by dust mites in Al-Hasa</td>
</tr>
<tr>
<td></td>
<td>2. Evaluation of the effect of three pesticides on the dust mite infestation</td>
</tr>
<tr>
<td></td>
<td>3. Survey of lesser date moth</td>
</tr>
<tr>
<td></td>
<td>1. Effect of three irrigation systems (drip system – bubbler system – floods system) on growth, yield and fruit quality of Barhee variety using treated sewage water</td>
</tr>
<tr>
<td></td>
<td>2. Effect of black plastic mulching on weed control, growth and yield of Barhee variety using drip irrigation system</td>
</tr>
<tr>
<td></td>
<td>3. Effect of irrigation schedules and kind of mulching on date palm (Phoenix dactylifera L.) growth, production and fruit quality under water scares conditions in Al-Shuhada area of Kuwait</td>
</tr>
<tr>
<td></td>
<td>Fertilization: 1. Effect of three kinds of fertilizers with three different quantities on growth, yield and fruit quality of Barhee variety using drip irrigation</td>
</tr>
<tr>
<td></td>
<td>2. Effect of monthly applications of fertilizers NPK (18:18:18) on the growth, yield and quality of Barhee variety using drip irrigation</td>
</tr>
<tr>
<td></td>
<td>3. Effect of foliar application of microelements on growth, yield and quality of Barhee variety using drip irrigation</td>
</tr>
<tr>
<td>1. Crop Management</td>
<td>1. Survey study of on the existing dates’ packaging containers in Saudi Arabia and their acceptance by the consumer</td>
</tr>
<tr>
<td>2. Integrated Pest Management</td>
<td>DNA extraction and fingerprinting of 5 selected date palm cultivars</td>
</tr>
<tr>
<td>3. Post-harvest techniques</td>
<td>Effect of harvesting stage, packaging techniques and storage on the reduction of post-harvest losses</td>
</tr>
<tr>
<td>4. Biotechnology</td>
<td>Assessment of genetic diversity in date palm</td>
</tr>
</tbody>
</table>
### 4. State of Qatar

|                    | 2. Response of date palm to irrigation with treated sewage water |
| 2. Integrated Pest Management | Up Till November-2010, no activity was carried out or planned to initiate the following activities:  
|                    | 1. Survey study for the identification of the major pests and diseases in Qatar and their natural enemies.  
|                    | 2. Ecological studies of major pests.  
|                    | 3. Development of Data Base for pests and diseases in Qatar |
| 3. Post-harvest techniques | The effect of three different solar drying techniques on scaling of dates (flakiness). |
| 4. Biotechnology | 1. Genetic Biodiversity of Qatar date palm varieties using SSR markers  
|                  | 2. SSR markers as sex identification key for date palm  
|                  | 3. New microsatellite markers for assessment of genetic diversity in date palm |

### 5. State of the United Arab Emirates

| 1. Crop Management | 1. Assessment of date palm water requirements using different irrigation systems |
| 2. Integrated Pest Management | Study the efficacy of different pesticides on Dust mite infestation |
| 3. Post-harvest techniques | 1. Comparison between using solar energy for drying dates under plastic houses and the automatic drying chamber (with controlled temperature and relative humidity)  
|                           | 2. Identification of the best harvesting stage for improved drying and marketing of Barhee, Khalas and Lulu date palm cultivars  
|                           | 3. Evaluation of the total cost, running cost and production capacity of the tested drying methods |
| 4. Biotechnology | Assessment of genetic diversity of date palm varieties of UAE |

### 6. Sultanate of Oman

| 1. Crop Management | 1. Studies on the low fruit set in Zabad Cultivar:  
|                    | • Effect of pollen grain source  
|                    | • Studies on the female receptivity period and  
|                    | • Effect of Boron foliar application on fruit set  
| 2. Studies on the variation of ripening dates of Nighal date palm cultivar |  
|                    | • Studies on the climatic conditions and  
|                    | • Effect of Pre-harvest Applications of Ethrel (Ethephone)  
|                    | • Effect of pollen grains source.  
|                    | • Effect of Fruit Thinning  
|                    | • Effect of pre-harvest application of Ethrel.  
| 4. Effect of mulching with pruned leaves of date palm on irrigation water availability and date palm growth, yield and fruit quality |
| 2. Integrated Pest Management | 1. Efficacy of different pesticides against Lesser Date Moth  
| 3. Post-harvest techniques | Production of citric acid from dates |
| 4. Biotechnology | 1. Assessment of genomic tools for germplasm characterization in date palm  
|                   | 2. Assessment of abnormalities found in the tissue culture derived date palms |
Annex 5

Meetings
Project monitoring Committee Meetings

Technical Coordination and Steering Committee Meetings (TC and SC meetings) were conducted regularly to monitor the progress of the project, to share the results and to make sure that the activities undertaken are within the scope of the research strategy adopted by the (NARS) of the participating countries and eventually adopt any necessary measures. From the year 2005 till 2010, six such meetings were held as follows:

1. First meetings held in Aleppo, Syria in May 18-19, 2005
2. Second meetings held in Muscat, Oman in March 27-28, 2006
3. Third meetings held in Muscat, Oman in March 18-19, 2007
4. Fourth meetings held in Muscat, Oman in May 11-14, 2008
5. Fifth meetings held in Manama, Bahrain in January 10-12, 2010
6. Sixth meetings held in Muscat in February 6-8, 2011.

Post-harvest meeting report
Ras Al-Khaima, UAE, March 2009

A. Participants
B. Program
C. Introduction
All participants expressed their full satisfaction with the meeting which gave them the opportunity to assess the progress achieved so far on this theme in each country, share the results and exchange their experiences and other related information. They were also pleased with the fact that there was no work duplication among the concerned NARS.
D. Presentations

**UAE**

1. Comparison between using solar energy for drying dates under and plastic houses and the automatic drying chamber (with controlled temperature and relative humidity).
2. Identification of the best harvesting stage for improved drying and marketing of Barhee, Khalas and Lulu date palm cultivars.
3. Evaluation of the total cost, running cost and production capacity of the tested drying methods.

Results obtained so far
The comparison between the three drying methods showed effectiveness of the glasshouses in shortening the drying period and improving quality of the dried fruits. Based on this, the Ministry of Environment and Water of the UAE allocated more than two million Dirhams for the establishment of 58 similar structures in different areas of the country. The economic studies need more refinement, more in-depth research and more accurate data before the work can be regarded as finished.
Future activities
Future research will focus on the effect of solar drying in glasshouses on pest infestation and quality of the dried dates.

QATAR
Workplan
The effect of three different solar drying techniques on scaling of dates (flakiness).
Results obtained so far
The work consisted of comparing direct sun drying with drying under plastic tunnels and locally designed plastic chambers with internal shelves, to be used at the grower’s level. The effectiveness of these chambers in shorting the drying period (5 days only against 12 days under plastic tunnels and 14-18 days for direct sun drying) and reducing scaling was demonstrated. Furthermore, dried dates from the chamber were much cleaner.
Future activities
Future work will concentrate on improving these chambers and studying the quality of the dried fruits.

SULTANATE OF OMAN
Workplan
Production of citric acid from dates
Results obtained so far
The main objectives of this work can be regarded as achieved. It was shown that the use of the submerged technique gave better results when compared to the surface technique in reducing the fermentation period. Moreover, the researchers could identify citric acid successfully by applying house-developed analytical method. However, delays in achieving these results were experienced due to the breakdown of some equipment and the long time required fixing it.
Future activities
Forthcoming work will concentrate on the effect of the date palm genotype on the production of citric acid as well as on the attempt to produce other value-added products.

KUWAIT
Workplan
The effect of harvesting stage, packaging and storage techniques on the reduction of post-harvest losses.
Results obtained so far
The presentation needs improvements and the results were not clear and need to be revised in terms of the variations in the fruit quality for each storage temperature. More accurate tests and statistical analysis of the results have to be carried out.
Future activities
Future work will concentrate on the effect of storage temperature and the type of packaging container on the final quality of the dates.
SAUDI ARABIA

Workplan
Survey study on the existing dates packaging containers in Saudi Arabia and their acceptance by the consumer.

Results obtained so far
Appreciable progress has been made in terms of the existing dates’ packaging containers, their labeling and the degree of their acceptance by the consumer.

Future activities
Future work will focus on the effect of packaging containers on the dates’ quality and on dates microbial contaminations and infestation.

Recommendations
The date palm specialist and project coordinator emphasized the need for:
1. Improved slide quality enabling easy reading
2. The use of English language for all written documents to reach a much larger audience and enable non-Arabic speakers to understand the presentations. As decided by the Steering Committee, the oral presentation can be either in Arabic or English
3. Statistical analysis of the data should be provided whenever applicable.

In conclusion, all the participants agreed that:
1. More efforts should be dedicated to the improvement of the dates to meet the international export standards particularly in industrial countries.
2. Seek alternatives for optimal use of the low quality dates through the production of value-added products and byproducts.
3. Use high quality dates surplus for the production of baby food and healthy foodstuff.
4. Increased capacity building of the participating NARS through workshops, symposia, conferences, visits, and short term training in more advanced laboratories.

Crop Management Meeting Report
Kuwait, April, 2009

A. Objectives of the meeting
1. Present the approved crop management workplan for each country.
2. Share the undertaken experiments and the results obtained so far.
3. Discuss the planned activities for 2009-2010.

B. Program of the meeting
C. List of participants
D. Presentations
a. **Approved crop management Workplan**

a.1. Studies on the low fruit set in Zabad Cultivar.
   a.1.1. Effect of pollen grains source.
   a.1.2. Studies on the female receptivity period.
   a.1.3. Effect of ‘Boron” foliar application on fruit set.

a.2. Studies on the variation of ripening dates of Nighal date palm cultivar.
   a.2.1. Studies on the climatic conditions.
   a.2.2. Effect of Pre or Post-harvest Applications of Ethrel (Ethephone)

a.3. Studies on the Improvement of Yield and Fruit Quality of Khalas cv.
   a.3.1. Effect of pollen grains source.
   a.3.2. Effect of Fruit Thinning.
   a.3.3. Effect of pre-harvest application of Ethrel.

a.4. Effect of mulching with pruned date palm leaves on irrigation water availability and date palm growth, yield and fruit quality.

b. **Obtained results**

a.1. Studies on the low fruit set in Zabad Cultivar.
   a.1.1. The results showed no effect of the different pollen grain sources on fruit set. Since the metaxenial effects are well established, these results might be due to the fact that the males used were from the same area and might be genetically very close to the female trees. The use of males from other regions or countries as well as the use of pollen grain from other phoenix species (sylvestris) might be beneficial for future work.
   a.1.2. Study on the receptivity period of the female flowers: The work was carried out in 1997 by Dr. Issam and the results have been published.
   a.1.3. The study showed no effect of three borax concentrations on fruit set and fruit quality of the Zabad cultivar.

a.2. Studies on the variation of ripening dates of Nighal date palm cultivar.
   a.2.1. Studies on the climatic conditions: The experiment could not be carried out because weather stations were not established in the locations of the study.
   a.2.2. Effect of Pre or post-harvest Applications of Ethrel (Ethephone): The results showed no effect of the three concentrations of ethephone on the fruit ripening, shrinking and dropping both for pre and post-harvest applications.

a.3. Studies on the Improvement of Yield and Fruit Quality of Khalas cv.
   a.3.1. Effect of pollen grains source: Significant differences were found between the 2 locations: The pollination efficiency was better in the Interior dryer region than in the more humid Albatinah costal area. However, no significant differences were found between the effects of different pollen sources on the fruit set of Khalas cultivars.
   a.3.2. Effect of Fruit Thinning: The study showed no significant differences in fruit ripening but significant differences were observed in total yield, fruit weight and length, and between the locations for most of the characters studied.
   a.3.3. Effect of pre-harvest application of Ethrel: While in the presentation no data was presented, in another report, it is indicated that the undertaken study
showed a significant effect of ethephon on fruit ripening without any shrinkage or drop. No results concerning the yield were presented.

a.4. Effect of mulching on irrigation water availability and date palm growth, yield and fruit quality. The effects of mulching with pruned leaves and plastic were compared. However, because of the failure of some equipment, the experiment was delayed.

a.5. Characterization of Date palm cultivars – GCC Atlas (Khalas, Fard, Khasab, Naghal and Zabad). The tree, leaves, flowering, fruit, and seed characteristics will be used to characterize these five cultivars.

c. Future activities

c.1. Selection of best males for pollination. The work will be pursued using palm males from other regions or countries as well as the pollen grain from other Phoenix species (sylvestris).

c.2. Pursue the work on mulching.

c.3. Characterization of the five selected Omani date palm cultivars.

Kingdom of Saudi Arabia

a. Approved workplan

a.1. Selection and evaluation of the male date palms used for pollination in Al-Ahsa oasis.

a.2. Study of the effects of pre-harvest holding of irrigation on date palm Khalas variety. fruit cracking.

b. Obtained results

a.1. Selection and evaluation of the male date palms used for pollination in Al-Ahsa oasis. The preliminary results clearly show the effect of the males on fruit length and weight. However, the presentation did not contain any statistical analysis as well as the conclusion summarizing the main findings. These issues should be included in the final report to strengthen the research.

a.2. Study of water deficit on date palm Khalas variety fruit cracking

Taking into consideration the comments made during the 4th Technical Committee and Steering Committee meetings the colleagues, rightly changed the experimental design. Thus, instead of withholding irrigation just before harvest, they applied specific water quantities throughout the year (100%, 50%, 33%, and 25% of commonly used quantities). Again, the presentation did not show any statistical analysis and conclusions. The results clearly indicated that the water deficit did not have any effect on fruit cracking. These results are in agreement with those obtained in the USA where date cracking seem to be related to soil type and/or fertility.

c. Activities for 2009-2010

1. Selection of the male pollinators: because of the very high date palm males available in Al-Hassa and the time, energy and efforts needed to evaluate all of them; it is highly recommended that the experiment should be redesigned to use only the males which have been selected over the years by the growers both in Al-Hassa and other regions of the kingdom and in other countries including males from species other than dactylifera. Furthermore, in addition to fruit weight and length, seed (weight, size, shape, etc.) and fruit (yield, size, shape, chemical analysis, etc.) characteristics should be added to really assess the metaxenial effects and avoid any biased data resulting
from the use of botanically related males to the females used in the experiment. If these comments are taken into consideration, great and useful results can be expected from this research.

2. **Fruit cracking:** Based on the obtained results in the Kingdom of Saudi Arabia and the USA, the study should be redesigned to address the effect of soil texture, fertility and fertilizers on dates’ cracking.

**State of Qatar**

*a. Approved Crop management workplan*

1. The effect of fruit thinning on the fruit quality of Khalas variety.
2. Response of date palm to irrigation with treated sewage water.

*b. Obtained results*

b.1. The effect of fruit thinning on the fruit quality of Khalas variety. Fruit thinning improved both the yield and other fruit characteristics. The work was extended to include Barhee but no results were obtained yet with this variety.

b.2. Response of date palm to irrigation with treated sewage water: The work was postponed until the work on the connection to the water source and the installation of the irrigation system is over (Trial expected to start in September 2009).

*c. Activities for 2009-2010*

c.1. Fruit thinning

   The present experiment will be repeated for another year and statistical analysis carried out. The work will be extended to include other varieties. Growth regulators will also be tested as thinning agent.

**Kingdom of Bahrain**

*a. Approved Crop management workplan*

a.1. The effect of chemical and organic fertilizer on date palm growth and production in the Kingdom of Bahrain.

a.2. The effect of liquid pollination on dates quality and quantity in the Kingdom of Bahrain.

*b. Obtained results*

b.1. The effect of chemical and organic fertilizer on date palm growth and production in the Kingdom of Bahrain. No significant statistical differences were found between the treatments. However, this might be due to the way organic fertilizer was applied (in holes without mixing with soil)

b.2. The effect of liquid pollination on dates’ quality and quantity in the Kingdom of Bahrain. No significant statistical differences were observed between traditional hand pollination and liquid pollination. Thus, the latter is highly recommended because of cost reduction, easiness of application, use of simple equipment, and efficiency in execution.
c. Activities for 2009-2010

   c.1. Liquid pollination
   1. Repeat the experiment to confirm the results and extend the work to other varieties.
   2. Fruit chemical analysis carried out provided the necessary equipment is purchased.
   3. Test the efficacy of other spraying equipment.
   4. Include boron in the solution to enhance pollen germination.
   5. Carry the same experiment in farmers’ orchards.

   c.2. Fertilization.
   Repeat the same experiment with organic fertilizers mixed to soil before the pre-irrigation and spread all around the trees.

   c.3. Characterization of the five selected cultivars.

State of the United Arab Emirates

a. Approved Crop management workplan: Assessment of date palm water requirements using different irrigation systems

b. Obtained results.

b.1. Assessment of date palm water requirements using different irrigation systems.
   The presentation was prepared by Eng. Mohamed Rashid Al-Naqbi, who is not a member of the research team and who had just come back from Australia. The objective of the research was not clear: If, as the title indicates, the main objective is to assess the water requirements of the date palm under different irrigation systems, then adult trees (12 years old and above) should have been used instead of three-year-old trees. If, as the presenter claimed, the objective is to determine the water requirements of the date palm at different stages of their development, the experimental design should be changed to include trees 1, 2, 3,……, 12 years of age. The issue could not be clarified by the speaker who was asked to check with the research team and submit a new report. Furthermore no clear response was provided as to how the applied water amount in 2006-07, 2007-08 and 2008-09 was obtained and no clear data was shown.

b.2. Economic Return and Environmental effect of organic farming on date palm trees.
   1. Although the experiment started in November 2007, it was not included in the submitted workplan for the UAE.
   2. The title is misleading: In fact, no economic studies were carried out to establish the economical return, no organic farming was done and no environmental effects were assessed. It is a very simple fertilization experiment.
   3. The experiment is poorly designed: The used levels of nitrogen and organic matter were not specified. The age of the trees was not indicated, no statistical analysis was carried out, and no conclusion was provided.
   4. Some of the presented data was not correct: The speaker claimed that four-year-old trees produced 17 Kg each and this seems to be very high.
c. Activities for 2009-2010
   c.1. Assessment of date palm water requirements using different irrigation systems. Repeat the experiment taking into consideration the above mentioned remarks.
   c.2. Fertilization: The experiment should be redesigned if to be pursued.

State of Kuwait

a. Approved Crop management workplan
   a.1. Irrigation
      a.1.1. Effect of irrigation schedules and kind of mulching on date palm (Phoenix dactylifera L.) growth, production and fruit quality under water scarce conditions in Al-Shuhada area of Kuwait
      a.1.2. Effect of three irrigation systems (drip system – bubbler system – floods system) on growth, yield and fruit quality of Barhee variety using treated sewage water
      a.1.3. Effect of black plastic mulching on weed control, growth and yield of Barhee variety using drip irrigation system.
   a.2. Fertilization
      a.2.1. Effect of three kinds of fertilizers, with three different quantities on growth, yield and fruit quality of Barhee variety using drip irrigation
      a.2.2. Effect of monthly application of fertilizers NPK (18:18:18) on the growth, yield and quality of Barhee variety using drip irrigation
      a.2.3. Effect of foliar application of microelements on growth, yield and quality of Barhee variety using drip irrigation

b. Obtained results
   • The combined effect of levels and source of chemical fertilizers on the productivity of date palm.
     1- Studying the effect of different levels of fertilizer on the growth and yield of date palm.
     2- Studying the effect of source of chemical fertilizers on the productivity of date palm.
   • Effect of irrigation schedules and mulching on growth and fruit yield of date palm.
     1- To find out the effect of irrigation schedules on the growth fruit yield and quality of date palm.
     2- To evaluate the influence of water conservation technique that is the use of mulches on the sustainable production of date palm.
     3- To find out the interaction effect of irrigation schedules and water conservation technique on the growth, fruit yield and quality of date palm.
     4- To work out the water requirement and water use efficiency of date palm under the scarce conditions of water in Kuwait.
Comments:
1. No data was presented for the fertilization experiments.
2. No conclusion was presented.
3. No statistical analysis for the irrigation experiments.
4. Are the results shown in the table in slide 19 for irrigation or fertilization?
5. The title for the table in slide 24 is missing.

c. Activities for 2009-2010
1. Pursue the experiments above taking into consideration the above comments.
2. Start the other experiments included in the submitted workplan.
3. Undertake experiment on heavy metals that might come from the treated sewage water.

E. Concluding comments
- Take into consideration the comments made by the participants in submitting final report.
- All the participants underlined the importance of the meeting and its benefits.
- The date palm knowledge bank project was debated and all the participants expressed its importance.
- There is a need to improve the quality of the presentations and in using English language.
- The date palm specialist suggested that in the future the research should concentrate on new trends such as:
  1. Mechanical pollination using liquid solution.
  2. Chemical thinning.
  3. Higher planting densities.
  4. Foliar application of fertilizers.
  5. Organic farming.
  6. Processing of dates for the production of high value products.
  7. Grow dates for new purposes such as production of anti-oxidants.

IPM Meeting Report
Manama, Kingdom of Bahrain, March 2009

A. Objectives of the meeting.
1. To present the approved IPM workplan for each country.
2. To share the undertaken experiments and the results obtained so far.
3. To discuss the planned activities for 2009-2010.

B. Program of the meeting
C. List of participants
D. Presentations
UAE

Theme: Study the efficacy of different pesticides on Dust mite infestation.

Major results: Among the tested pesticides, the most effective ones against the Dust mites were identified.

Future Activity: The experiment will be repeated another season for confirmation of the results and test five new pesticides.

KSA

Theme 1: Conduct survey and assess the infestation level by dust mites in Al-Hasa

Major results: Two dust mite species were found: Oligonychus afrasiaticus Mcg and Tetranychus sp.

Future Activity: Continue survey for another year and determine which of the two dust mite species is predominant.

Theme 2: Evaluation of the effect of three pesticides on the dust mite infestation.

Results: Up to now, no concrete results were obtained.

Activities for 2009-2010: The experts suggested the use of RCBD with four replications instead of three planned by the investigators.

Theme 3: Survey of Lesser Date Moth.

Major results:
1. All the insect’s life cycle stages were studied in the laboratory.
2. The degree of field infestation varied between regions from 5 to 90%.
3. Traps to get natural enemies were installed in the field.
4. Observations on some natural enemies were made, but the estimation of the degree of parasitism needs to be carried out.
5. It is worth mentioning that a local natural enemy of the date palm borer was recorded for the first time and identified by the British Museum of Natural History.

Activities for 2009-2010:
1. Use of light traps to assess the importance and distribution of the insect and determine the number of its generations.
2. Localize the sites of the insect dormancy (?)..
3. Assess the efficacy of 2 biological agents for the control of the insect.
4. Search for the natural enemies of the insect whenever present.

Kuwait

Theme: Survey of pests and diseases of date palm.

Major results: 13 diseases and six pests associated with the date palm in Kuwait were recognized. An insect predator was also found.

Future Activity:
1. Identification of the major diseases and pests.
2. Development of an IPM program for these major diseases and pests.
Qatar

Up to now, the State of Qatar did not carry out any experiment on IPM. They will start their activities in this field in 2010 and they are planning to undertake the following:

**Theme 1:** Survey study for the identification of the major pests and diseases in Qatar and their natural enemies.

**Theme 2:** Ecological studies of major pests.

**Theme 3:** Development of Data Base for pests and diseases in Qatar.

Oman

**Theme 1:** Efficacy of different pesticides against lesser date moth.

**Major results:** Five environment friendly insecticides have been evaluated for second season to confirm their efficacy against lesser date moth (*Batrachedra amydraula* Meyrick). The results obtained in 2008 indicated that at least three pesticides showed a good level of efficacy. However, due to the late stage infestation at the time of trial, these results were not in agreement with those obtained in 2007.

**Future Activity:** This experiment will be repeated another season but at an earlier stage of infestation to confirmation the results

**Theme 2:** Survey of natural enemies.

**Major results:** Four parasitoid and three predator species found.

**Future Activities**:
1. Continue the survey of natural enemies of *B. amydraula*.
2. Evaluating the efficiency of *Goniozus* sp. in controlling the pest.
3. Susceptibility of different varieties of date palm to the *B. amydraula* infestation.
4. Study the possibility of mass rearing the LDM larval parasitoid and its field release.
5. Identification of sex pheromone for the LDM.

Bahrain

**Theme:** Faunal Survey of Insects and Mites Associated with Date Palm in Kingdom of Bahrain.

**Major results:**
1. 184 species representing nine orders were collected using light traps.
2. 74 species representing nine orders using were collected in Pitfall Traps.
3. Several natural enemies (predators, entomopathogenic fungi) of the date palm pests have been found.

**Future Activities**
1. Continue the survey.
2. Send the specimens for species identification.
3. Assess and map the distribution and the importance of the major pest in the country.
4. IPM program for the major pests needs to be developed.
5. Publish the results.
It is worth mentioning that the participants visited the laboratory that was equipped by the project’s funds and were very pleased with the great job carried out in Bahrain under the leadership of Dr. Abdul Aziz Abdul Kareem.

Biotechnology Meeting Report
Rumais, Sultanate of Oman, 2009

A. Agenda of the meeting:
B. Participants:
C. Objectives of the meeting
   1. To present the approved biotechnology workplan for each country.
   2. To share the undertaken experiments and the results obtained so far.
   3. To discuss the planned activities for 2009-2010.
D. Country reports
The major activities which were approved were to fingerprint all the major date palm varieties in the Gulf countries and to assess the amount of variation between and within varieties. Oman and Qatar are the lead countries for biotechnology with an annual budget of US$ 40,000.00 each while the other countries receive US$ 17,000.00 annually.

Since only Oman had a functional laboratory, it was agreed that the countries would extract the DNA of their selected five date palm varieties and sent it to Oman for analysis. The countries would meanwhile work to develop their own facilities.

Kingdom of Saudi Arabia
a. Approved workplan: DNA extraction and fingerprinting of five selected date palm cultivars.
b. Presentation and obtained results by Eng. Hussain Buawais: Fingerprinting of 25 date palm cultivars in the Kingdom of Saudi Arabia including the study of the Intra-varietal variation in vegetatively propagated date palm and documenting the genetic resources of date palm cultivars in an Atlas. The main objectives were to test the different DNA extraction protocols including the use of BioRobot in Saudi Arabia and send the samples to Oman for analysis. Samples include the main cultivars grown in different regions of the Kingdom. The extracted DNA was sent to Oman for analysis and is waiting for the results. The speaker also presented the list of equipment purchased by the date palm project funds such as the QIAcel system for DNA analysis. This is a gel electrophoresis system that can separate DNA. Their lab facilities has further a gel documentation system, PCR machine etc.
c. Workplan for 2009-2010: They will extract DNA samples from 25 cultivars grown in the Kingdom: group1 (9 Cvs), group 2 (8 Cvs) and group 3 (8 Cvs) and send them to Oman for analysis.
Kingdom of Bahrain

a. **Approved workplan:** Development of genomic tools for germplasm characterization and genetic diversity in date palm with the main objectives being:
   1. Characterization of the date palm cultivars in the kingdom of Bahrain.
   2. Identification and documentation of the genetic differences between Bahraini cultivars using molecular analysis.
   3. Studying the genetic diversity between and within cultivars.
   4. Documentation of the germplasm characterization and its genetic diversity in the ATLAS for the GCC date palm cultivars.

b. **Presentation and progress** by Eng. Amani Abu Edrees.
   DNA was extracted from five Bahraini cultivars from 10 different regions using and comparing DNeasy Plant Maxi Kit (Qiagen) and CTAB DNA Extraction Methods. The CTAB procedure provided better results. The samples were sent to Oman but no results were received.

c. **Planned activities for 2009-2010:**
   1. DNA extraction from five new cultivars with 10 replications will be done using the CTAB Protocol and sent to Oman for analysis.
   2. While technical expertise, a thermo-cycler and a vertical electrophoresis system are available in the University of Bahrain, in the long run viable laboratories should be established within the Ministry of Municipalities and Agricultural Affairs. Since only about US$ 4000 were spent from the biannual budget of US$ 34,000. These allocated funds should be spent to supply the laboratory with the essential equipments required for in vitro culture and molecular experimental studies.

The speaker also raised the communication problems with both the National coordinator and the technical Coordinator.

State of Kuwait

a. **Submitted workplan:**
   1. In vitro propagation of elite date palm varieties like Barhee.
   2. Assessment of genetic diversity in date palm.

b. **Presentation by Eng. Shaimaa Al-Khabbaz:** Documentation of genetic resources of date palm in an atlas. DNA samples of four cultivars from 10 different locations were extracted using Maxi kits from Qiagen and sent to Oman. The DNA extraction was carried out at KISR. However, the quality of DNA was bad and the extraction had to be redone in Oman. Kuwait is still waiting to receive the results from Oman.

c. **Plans for 2009-2010:**
   1. DNA extraction from five other varieties will be carried out.
   2. Make use of the technology for:
      - Identification of date palm diseases.
      - Study mutation of date palm cultivars in Kuwait.
3. Establish a well equipped laboratory with all the necessary equipments for biotechnology.

State of United Arab Emirates

a. Approved workplan: No activities were planned in biotechnology because their laboratory was being used by Al-Rajhi Company from Saudi Arabia following the agreement signed between the Ministry of Environment and Water of the UAE and the company to transfer the organogenesis technique for the production of date palm vitro-plants.

b. Activities undertaken: DNA was extracted from five Emiratis cultivars and sent to Oman. However, the quality was bad and the scientists from UAE and Oman agreed that the DNA will be re-extracted in Oman.

c. Plans for 2009-2010: New attempt to extract the DNA in Oman will be done.

State of Qatar

a. Submitted plan for Germplasm conservation: Formation of a working group with the purpose of acquiring the required information for the production of DATE PALM ATLAS.

b. Achievements: It was not clear what has been achieved in Qatar. They are still developing their own biotechnology center and are waiting to have functional facilities. Dr. Khaled Mabrouk presented a publication by Dr. Talaat studying the diversity of 15 Qatar date palm cultivars with microsatellite primers.

c. Future plans: If the laboratories will become functional in the next 3-4 months (equipment has been ordered) DNA will be extracted and either sent to Oman or processed in-house. However, the need to clarify the amount of the available funds with the national coordinator and to clearly assign responsibilities, were emphasized.

Sultanate of Oman

a. Approved workplan

   Development of genomic tools for germplasm characterization in date palm with the objectives of:
   1. Testing and evaluating the best AFLP and micro- satellite primer combinations for cultivars fingerprinting (Oman).
   2. Using AFLP fingerprinting technique and the existing micro- satellite markers on five GCC cultivars.
   3. Start mapping or identifying molecular markers linked to traits of interest (sex identification).

   Assessment of abnormalities found in the tissue culture derived date palms.
   1. Survey amount and characterize the type of the main abnormalities associated with tissue culture derived palms.
   2. Fingerprint the mutated palms and compare them with their respective cultivars.
b. Presentation by Dr. Ishaq Al-Ruqaishi: Use the Best Microsatellite Primer Combinations on GCC Date Palm Cultivars for Fingerprinting using the DNA samples from Oman and the other with the main objectives being:

1. Development of genomic tools for germplasm characterization in date palm.
2. Assessment of genetic diversity in date palm.

DNA has been extracted (with DNeasy kit from Qiagen) from five varieties (with 10 replications). From 33 available primers for date palm, 20 had been tested on Omani cultivars and analyzed on CEQ8000 genetic analyzer (Beckman Coulter). Data generated on the sequencer has been analysed with NTSYS program. Data was presented on using four SSR primers on date palm DNA from several different countries (Oman, Saudi Arabia, and Bahrain). Clustering analysis has shown that major varieties such as Khalas from Oman, Saudi Arabia and Bahrain, cluster together, even though substantial variation within the variety was revealed.

The achievements made so far were summarized as follows:

1. SSR primer combinations were tested and evaluated for fingerprinting of date palm cultivars (Oman, Saudi Arabia, Bahrain and Kuwait).
2. Out of 33 primers were selected, 20 were tested for further analysis based on the intensity of the bands.
3. Allelic size of each microsatellite primer combination of date palm cultivars were observed and recorded as present (1) or absent (0).

c. Future Activities:

1. Receive remaining DNA samples from GCC countries and analyze using 30 SSR primers.
2. Scoring the amplification products on CEQ 8000 DNA analyzer.
3. Data collection.
4. Data analysis.

Some inconsistencies need to be clarified: In the presentation, the DNA samples from the UAE were included in the analysis while in the meeting it was clearly said that such samples were not good and it was agreed that the extraction will be done in Oman in the near future.

Some major difficulties have arisen regarding the cost of the analysis. Oman has suggested that each of the other countries should contribute US$14,212.00 to cover the cost of the primers and PCR analysis for the 50 samples with 30 SSRs, while they would cover the cost of the analysis on the sequencer in the amount of US$ 3,986.00. The countries could buy their own consumables and bring them to Oman while they also would help to do the analysis. Some of the countries have objected to this. If they were to pay US$ 14,212.00 for the chemicals, not much will be left for the establishment of the biotechnology facilities in their own countries.

ICARDA observations: the laboratory in Rumais, Oman has established the infrastructure for DNA analysis. However, scientists seem to rely heavily on kits for all steps in order to standardize the operation and avoid excessive individual handwork. While this can be justified, in countries where labor is costly, DNA analysis becomes unnecessarily expensive; e.g. ICARDA has executed under the Generation Challenge Program several projects on characterization of plant genetic resources. The program allocates US$ 1.00 for one SSR data point. Oman laboratory operates currently in the range of US$ 12.00 per polymorphic SSR analysis. Furthermore, when asked why the same primers could not be used for samples from different countries, Dr. Ishaq replied that the calculation was done if
the countries want to do their own analysis and this is not correct since it was decided that all the analysis will be carried out in Oman where the purchased sequencer has been installed.

**ICARDA recommendations:** the laboratory in Rumais can optimize some operations to reduce overall cost without compromising the quality through:

a. Testing all the 33 primers (un-labeled) on six diverse date palm varieties. Based on the results it should be possible to identify sets of three primers that could be analyzed together. The ideal situation would be to have 10 sets of three primers. These primers could then be ordered and labeled. By combining and analyzing the three SSRs together, the running cost will be reduced substantially (up to 60%).

b. Checking whether or not the primers could be multiplexed. This might not work for all 10 pools but for most of them. This will require time and expertise for optimization. If all 10 sets of three primers could be multiplexed it would again reduce the cost for PCR analysis substantially (up to 60%).

c. The potential of the automatic sequencer for combined runs and analysis has not been fully utilized. While it is possible with today’s software to analyze sequencer outputs for allele sizes (in bp), current results are being converted to binary data (1 0) with substantial amount of information lost for the data analysis in the conversion process.

d. The suggested amount of labeled primer used should be checked in the laboratory for possible reduction to save cost. In our laboratory at ICARDA, labeled primers are diluted 10 times the amount suggested by the supplier. This way we can perform about 2000 reactions with one labeled primer.

---

**Fifth Technical Coordination and Steering Committee Meetings' Report**

**Bahrain, January, 2010**

**Problem solving research**

The leading role for each thematic area of problem solving research was identified among six (GCC) countries and the first project report was submitted during the fifth Technical Coordination and Steering Committee Meetings of the Project on the Development of Sustainable Date Palm Production Systems in the (GCC) Countries of the Arabian Peninsula meetings held at Bahrain in January 10-12, 2010.

**Leading countries in problem solving Research Major Themes**

<table>
<thead>
<tr>
<th>Thematic Area of Research</th>
<th>Leading country of (GCC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Propagation and crop management</td>
<td>State of Kuwait</td>
</tr>
<tr>
<td>B. Crop protection and Integrated Pest Management</td>
<td>Kingdom of Bahrain and Saudi Arabia</td>
</tr>
<tr>
<td>C. Post-harvest techniques</td>
<td>State of United Arab Emirates</td>
</tr>
<tr>
<td>D. Biotechnology</td>
<td>State of Qatar and Sultanate of Oman</td>
</tr>
</tbody>
</table>

38
# Sixth Technical Coordination and Steering Committee Meetings' Report

**Muscat, Sultanate of Oman, February, 2011**

## Major Activities and Achievements of year 2010 and the Workplan for the year 2011

### A4.A Crop Management

<table>
<thead>
<tr>
<th>Activities Carried out – Year 2010</th>
<th>Concerned countries</th>
<th>Task Accomplished/Major Achievements</th>
<th>Workplan Year 2011</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Effects of Liquid pollination on dates' quality and quantity</td>
<td>Bahrain, Oman</td>
<td>Liquid pollination is as effective as the other known techniques but it is easier, faster and more economical.</td>
<td>To be continued at farm level in all (GCC) countries</td>
<td>Results can be transferred to growers for further testing and regular use.</td>
</tr>
<tr>
<td>2. Evaluation and selection of male date palms used for pollination in Al–Ahssa Oasis</td>
<td>KSA</td>
<td>1. Pollen viability and germination were excellent. 2. The male giving the largest fruits with highest weight were found for the three cultivars used in the experiment.</td>
<td>To be continued</td>
<td>As planned, the experiments will continue for a long time. It will be better to test only the males used by growers. The best male found will be then the control for male seedlings.</td>
</tr>
<tr>
<td>3. Effects of pre-harvest holding irrigation on date palm Khasal CV. Fruit cracking</td>
<td>KSA</td>
<td>Withholding irrigation before harvest is not related to skin separation of the fruit.</td>
<td>To be modified</td>
<td>Due to importance of the water issue in (GCC) countries work should be modified to study irrigation by using another water resources such as treated water</td>
</tr>
<tr>
<td>4. Effect of chemical and organic fertilizer on date palm production</td>
<td>Kuwait, and Bahrain</td>
<td>Under investigation.</td>
<td>To be continued</td>
<td></td>
</tr>
<tr>
<td>5. Effect of irrigation schedule and kind of mulching on date palm growth, production and fruit quality</td>
<td>Kuwait, Qatar and Oman</td>
<td>Under investigation</td>
<td>To be continued</td>
<td></td>
</tr>
<tr>
<td>6. Effect of source pollen grains on fruit set of Zabad CV.</td>
<td>Oman</td>
<td>The results indicated that Ghareef and Khoori gave the best effect on fruit set of Zabad whereas Bahlani gave the best effect on fruit weight.</td>
<td>To be continued</td>
<td>Results can be transferred and verified at farm level</td>
</tr>
<tr>
<td>7. Effect of ‘Boron” foliar application on fruit set Zabad- suspended for the year 2010</td>
<td>Oman</td>
<td>Using Boron on fruit set was ineffective and the experiments were suspended</td>
<td>To be suspended</td>
<td></td>
</tr>
<tr>
<td>8. Effect of pre-harvest application of Ethrel on Nighal dates ripening and quality</td>
<td>Oman</td>
<td>Significant effects of ethephone on the ripening, shrinking and dropping in Nighal cultivar- being tested at farm level</td>
<td>To be continued</td>
<td>Results can be transferred and verified at farm level both in Oman and other (GCC) countries.</td>
</tr>
</tbody>
</table>
9. Effect of Post-harvest application of Ethrel on Nighal dates ripening and quality

<table>
<thead>
<tr>
<th>Concerned countries</th>
<th>Task Accomplished/Major Achievements</th>
<th>Workplan Year 2011</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oman</td>
<td>Significant effects of ethephone treatments only in respect to fruit ripening</td>
<td>To be continued</td>
<td>Results can be transferred and verified at farm level both in Oman and other (GCC) countries.</td>
</tr>
</tbody>
</table>

10. Effect of source of pollen grains on fruit set, ripening time and fruit quality of Khlas CV

<table>
<thead>
<tr>
<th>Concerned countries</th>
<th>Task Accomplished/Major Achievements</th>
<th>Workplan Year 2011</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oman</td>
<td>The effect of the source of pollen grains on fruit set being tested at farm level</td>
<td>To be continued</td>
<td>Results can be transferred and verified at farm level both in other (GCC) countries</td>
</tr>
</tbody>
</table>

11. Effect of fruit thinning on the fruit quality of Khlas CV

<table>
<thead>
<tr>
<th>Concerned countries</th>
<th>Task Accomplished/Major Achievements</th>
<th>Workplan Year 2011</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qatar, Oman</td>
<td>Thinning to improve ventilation proved very effective and results are being transferred</td>
<td>To be continued</td>
<td>Results can be transferred and verified at farm level both in other (GCC) countries</td>
</tr>
</tbody>
</table>

12. Effect of three irrigation systems (drip system – bubbler system – floods system) on growth, yield and fruit quality of date palm varieties using treated sewage water

<table>
<thead>
<tr>
<th>Concerned countries</th>
<th>Task Accomplished/Major Achievements</th>
<th>Workplan Year 2011</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kuwait, UAE</td>
<td>Bubblers seem to be the best irrigation system for the date palm</td>
<td>To be continued</td>
<td>Results can be transferred and verified at farm level both in other (GCC) countries</td>
</tr>
</tbody>
</table>

13. Economic Return and Environmental effect of organic farming on date palm trees

<table>
<thead>
<tr>
<th>Concerned countries</th>
<th>Task Accomplished/Major Achievements</th>
<th>Workplan Year 2011</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>UAE</td>
<td>Under investigation</td>
<td>To be continued</td>
<td>To be continued</td>
</tr>
</tbody>
</table>

A4.B Crop Protection and Integrated Pest Management (IPM)

<table>
<thead>
<tr>
<th>Activities Carried out –Year 2010</th>
<th>Concerned countries</th>
<th>Task Accomplished/Major Achievements</th>
<th>Workplan Year 2011</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Efficacy of different pesticides against lesser date moth</td>
<td>Oman</td>
<td>1.Two pesticides were found effective in reducing fruit infestation: Trebon® 20%EC and Kingbo® 0.6%SL</td>
<td>To be continued</td>
<td>To be continued</td>
</tr>
<tr>
<td>2. Survey of natural enemies for LDM</td>
<td>Oman</td>
<td>Some natural enemies for the control of LDM were identified and their evaluation is under way; Survey for additional natural enemies of LDM is also being carried out</td>
<td>To be continued</td>
<td></td>
</tr>
<tr>
<td>3. Survey of pests and diseases, ecological studies and establishment of a database</td>
<td>Qatar</td>
<td>No activity carried out</td>
<td>To be continued</td>
<td>1. Survey study for the identification of the major pests and diseases in Qatar and their natural enemies. 2. Ecological studies of major pests. 3. Development of Database for pests and diseases in Qatar</td>
</tr>
</tbody>
</table>
4. **Survey of main insect pests and diseases affecting date palm**
   - **Kuwait KSA**
   - **To be continued**

   1. More than 305 pest species representing 22 genera were identified in Bahrain, Kuwait and KSA; Seventeen predators were found to be effective control against major pest LDM.
   2. Two bio-pesticides were found effective in controlling infestation by borers and mites (Kingbo and Agri2000).

5. **Survey and assess the infestation level by dust mite in Al-Hassa.**
   - **KSA**
   - **To be continued**

   Two dust mite species were found: *Oligonychus afrasiaticus* and *Tetranychus spp*.

6. **Evaluation of the effect of three pesticides on the dust mite infestation**
   - **KSA**
   - **To be continued**

   One botanical pesticide Baicao No.1 (0.36% Matrine) gave a good level of control against dust mite; The biopesticide (Spinosad) gave a good level of control against LDM.

7. **Faunal Survey of Insects and Mites Associated with date palm using pitfall traps**
   - **Bahrain**

   From light traps: 184 species representing nine orders were identified from light traps; 74 species representing nine orders were found in pitfall traps.

   1. Shipping specimens' for identification
   2. Preparing distribution map for major date palm pests
   3. Preparing profiles of major date palm pests

8. **Evaluation of bio-pesticides for the control of dust mite**
   - **UAE**

   Two bio-pesticides were found effective in controlling infestation by borers and mites and they will be tested in the other (GCC) countries; The biopesticide Baicao No.1 (0.36% Matrine) gave a good level of control against dust mites.

   Test more bio-pesticides for the control of dust mite.
## A4.C Post-harvest Techniques

<table>
<thead>
<tr>
<th>Activities Carried out – Year 2010</th>
<th>Concerned countries</th>
<th>Task Accomplished/Major Achievements</th>
<th>Workplan Year 2011</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Effect of solar drying under glasshouses on the infestation and the quality of the dried dates</td>
<td></td>
<td>1. The effectiveness of the glasshouse in shortening the drying period and in improving the quality of the dried fruits was shown. 2. Drying dates in glasshouses transferred to growers in the UAE</td>
<td>To be continued</td>
<td></td>
</tr>
<tr>
<td>2. Identification of the best harvesting stage for improved drying and marketing of Barhee, Khala's and lulu date palm cultivars</td>
<td>UAE</td>
<td>The best fruit quality and reduced skin separation were obtained when fruits are harvested at Tamar stage. Harvesting at Rutab stage is to be avoided</td>
<td>To be continued</td>
<td>Technology transfer to growers</td>
</tr>
<tr>
<td>3. Evaluation of the total cost, running cost and production capacity of the tested drying methods.</td>
<td></td>
<td>The economic studies need more refinement, more in-depth research and more accurate data before the work can be regarded as finished.</td>
<td>To be continued</td>
<td>The need for the involvement of an economist in this work was emphasized.</td>
</tr>
<tr>
<td>4. The effect of three different solar drying methods on the fruit cracking of the date palm Barhee, Khala's and Barhee CVs</td>
<td>Qatar</td>
<td>The effectiveness of locally made plastic chambers, equipped with shelves and ventilation in shorting the drying period (5 days only vs. 12 days under plastic tunnels and 14-18 days for direct sun drying) and in reducing skin separation was demonstrated. Further, dates, dried in the chamber were much cleaner.</td>
<td>To be continued</td>
<td>Other (GCC) countries need to test these chambers</td>
</tr>
<tr>
<td>5. Effect of date palm genotype on the production of citric acid from dates and other value added products</td>
<td>Oman</td>
<td>Effectiveness of submerged technique for the production of citric acid from dates demonstrated.</td>
<td>To be continued.</td>
<td>To test the effect of cultivars on the fermentation yield</td>
</tr>
<tr>
<td>6. Effect of harvesting stage, packaging techniques and storage on the reduction of post-harvest losses</td>
<td>Kuwait</td>
<td>Preliminary results concerning packaging containers and best storage conditions for important cultivars as well as their acceptance by the packing houses and by the consumer obtained</td>
<td>To be continued</td>
<td></td>
</tr>
<tr>
<td>7. Effects of the locally produced packaging materials on the chemical, physical and microbial characteristics of the dates and their acceptance by the consumer and physical analysis</td>
<td>KSA</td>
<td>Preliminary results concerning packaging containers and best storage conditions for important cultivars as well as their acceptance by the packing houses and by the consumer obtained</td>
<td>To be continued</td>
<td></td>
</tr>
<tr>
<td>Activities Carried out –Year 2010</td>
<td>Concerned countries</td>
<td>Task Accomplished/Major Achievements</td>
<td>Workplan Year 2011</td>
<td>Comments</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------------------</td>
<td>-------------------------------------</td>
<td>--------------------</td>
<td>----------</td>
</tr>
<tr>
<td>1. Development of genomic tools for germplasm characterization and genetic diversity in date palm</td>
<td>UAE, KSA, Kuwait Bahrain Oman, Qatar</td>
<td>Finger printing of local date palm cultivars carried out and their genetic diversity level established. Evaluation of newly developed SSR marker are underway</td>
<td>UAE samples need to be genotyped. Qatar will genotype their samples with the same SSRs. Genotyping will be completed for five samples per country with replications. Training will be provided for (GCC) scientist in the Oman facilities</td>
<td>Should be continue</td>
</tr>
<tr>
<td>2. Development of infrastructure for genomic analysis</td>
<td>UAE, KSA, Kuwait Oman Qatar</td>
<td>1. Facilities have been established and/or upgraded in Saudi Arabia and Qatar 2. Facilities for DNA extraction were established in Kuwait, Bahrain and UAE</td>
<td>To be continued</td>
<td></td>
</tr>
<tr>
<td>3. Characterization of abnormalities related to tissue-culture-derived palms</td>
<td>Oman</td>
<td>12 samples derived from tissue culture from the cultivar KhalasA’Dhahra and their mother were analyzed with 20 SSR markers, 315 alleles were detected but no variation found among in-vitro plants</td>
<td>More samples from (GCC) countries to be analyzed</td>
<td></td>
</tr>
<tr>
<td>4. Publication of Genome sequence of date palm by Cornell/Qatar – publication</td>
<td>Qatar</td>
<td>Developed 1000 SSR markers from the sequence and these were published in 2010</td>
<td>To be continued by utilizing the developed markers in the genetic mapping and genetic diversity analysis of date palm</td>
<td></td>
</tr>
</tbody>
</table>