UNDER THE PATRONAGE OF
H.H. SHEIKH NAHAYAN
MABARAK AL NAHAYAN
" THE PALM TREE IN THE
EYES OF THE WORLD "
AN INTERNATIONAL COMPETITION OF
PHOTOGRAPHY IN ITS 3rd SESSION -2012
CULTIVATION OF PHOENIX
DACTYLIFERA L. (DATE PALM) FOR
COMBATING DESERTIFICATION AND ENHANCED LIVELIHOOD

Volume No. 3, Issue No. 03, September 2011
KHALIFA INTERNATIONAL DATE PALM AWARD

Under the patronage of H.H. Sheikh Mansour Bin Zayed, Western Region organizes the 2011 Rutab/ Liwa Festival

The Blessed Tree

Photograph by: Liwa Date Festival 2011

Photograph by : Fatima Ali Salem Altawel - UAE
KHALIFA INTERNATIONAL DATE PALM AWARD ANNOUNCES
THE START OF APPLICATIONS FOR THE FOURTH SESSION 2012

In the following categories:

- Distinguished Research and Study
- Distinguished Producers
- The Best New Technique
- The Best Development Project
- Distinguished Figure

In addition to a trophy carrying the winner’s name there is a recognition certificate for researchers and professionals, producers, farmers and lovers of date palm tree.

First Winner: 300,000 AED
Second Winner: 200,000 AED

Application period runs: From 01 June – 30 October, 2011 (Five Months)
Submission of applications conforming to the conditions: From 01 – 30 November, 2011 (One Month)
The judging committee will study, review and evaluate the applications: From 01 – 31 December, 2011 (One Month)
Final evaluation: From 01 – 31 January, 2012 (One Month)
The winner’s names will be announced: In February, 2012.

Under the patronage of His Highness Sheikh Nahayan Mabarak Al Nahayan
Minister of Higher Education and Scientific Research
President of Board of Trustees

For further information, please contact:
Khalifa International Date Palm
P.O. Box: 82872, Al Ain, United Arab Emirates, Tel: +971 3 78 32 434, Fax: +971 3 78 32 550
Email: kidpa@uaeu.ac.ae, Website: www.kidpa.ae

www.kidpa.ae
Invitation to Researches, writers and interested Scientists

Out of the keen interest of Khalifa International Date Palm Award Secretariat General to spread the awareness and specialized knowledge in date palm industry across the world.

Therefore, we invite all academics, specialist researchers, producers and date palm (the blessed tree) lovers to participate in either languages Arabic or English in related matters and issues to date palm such as (cultivation, disease prevention, maintenance, food processing, marketing, ...) materials should satisfy publication criteria set out in the magazine.

We value and appreciate your good efforts made to serve the blessed tree.

Materials are to be sent to Head of Media Committee and editor-in-chief via email address: emadsaad126@gmail.com
Under the prudent leadership of H.H Sheik Khalifa Bin Zayed Al Nahyan, UAE President (may God protect him) the country played an eminent role in serving humanity worldwide at all levels. The choice of H.H, the President, as the Islamic Personality of the year for Dubai International Holy Quran Prize in its 15th session of 2011 is really the proper choice. H.H. is a pioneer in charitable and humanitarian activities, not only for his people but also for his services which go beyond the local boundaries to cover all the world.

Dubai International Holy Quran Prize in its 15th session was honored in choosing H.H, the President, (May God protect him) as the Islamic Personality for 2011. H.H. was awarded the prize for H.H. devotion to serve Islam and Moslems all over the world, an action which is embodied in the gifts, grants, projects and constructions that meet people's needs following the pathway of the late H.H Sheikh Zayed Bin Sultan Al Nahyan (God rest his soul).

The prize attained its goal in honoring H.H the President (may God protect him) who is well-known for H.H. generosity and merciful heart and who is so careful for serving the Holy Quran and its reciters, Islam and Moslems all over the world. This blessing choice gives us happiness to renew our loyalty, obedience and faithfulness. Moreover this choice is right, and it adds respect to the prize. H.H the President is famous for his human and charitable stands.

H.H the president deserves our respect, appreciation and loyalty not only because he is a prudent ruler but also because H.H. is a generous person whose personality embodies all the meanings of goodness and generosity. The prizes goes to the person who deserves it because H.H is capable of each and every national, human and great affair.

Nahyan Mabarak Al Nahyan

Minister of Higher Education and Scientific Research
Chairman of Khalifa International Date Palm Award Board of Trustees
The Arab region is considered the original home of date palm-tree, whereas our spiritual connection with the palm-tree is deep-rooted, and the tree as such is an integral part of our local culture and long history. It is the majestic tree which bears the weather harsh conditions throughout the year, and whose dates are the supply of the traveler and the food of the resident. In it we trace bless and from it we learn patience. Its dates are the healthy food that includes all the nutritious ingredients for human body. We are all aware of the importance of date palm and its fruits and the economic, social, heritage importance it represents, this is not to mention the necessity of exploiting dates and by-products in successful investment projects.

A look at the Arab world production of dates which exceeds 70% of the average of the world production and at the number of planted palm trees which constitute 90% of the total number of palm trees in the world would reveal the importance of the Arab serious work and the thoughtful future vision to maintain and invest in the date palm sector.

In spite of the success of some investments in the date palm sector, yet the focus in these investments and the suggestion of the investment strategic plans at the Arab level are still below the desired level because the traditional methods in producing and marketing are the most prevailing whereas the advanced technologies in food production are still very limited. Moreover, the Arab region is still lacking the strategy of effective production and promotion of dates and their products. In its turn, the General Secretariat of Khalifa International Date Palm Award has sensed the importance of palm trees and dates in its various research, marketing, manufacturing and productive aspects and the obstacles this sector faces that hinder its benefit in agricultural investments to support the economies of countries and their citizens as well the importance of maintaining this blessed tree.

Although there are some success achieved here and there in the Arab region, nevertheless we are all aware of the problems this sector faces which need the cooperation of all concerned scientists and researchers to study its problems and solve them and to develop the production and manufacturing of dates. The emergence of international and regional economic blocs and the liberation of international trade within the framework of International Trade Organization would lead to the opening the international markets before Arab dates and their derivatives and would double as well the degree of competition, a fact which necessitates the raising of the marketing and productive efficiency, decreasing production cost and increasing the quality of products and adherence to international standards. All this requires the increase of the exerted efforts by the public and private sectors in the various stages of date palm production and marketing.

Dr. Abdelouahhab Zaid
Secretary General of Khalifa International Date Palm Award
Editor in Chief
Publication criteria in the magazine

1. The Articles should be new, dedicated particularly to the Award’s magazine, and have not published before.

2. Articles are to be in a soft copy, whether in Arabic or English, and should be supported by specialized sources and references at the end.

3. Researches and studies should be accompanied by the required scientific photographs of high quality (digital / high resolution).

4. Articles and photographs are to be submitted to the magazine by e-mail, or to be sent to the Award’s P.O. Box on a CD with a typed and printed hard copy.

5. The magazine is not obliged to return the articles back, whether published or not, to the participants.

6. A writer of an article should enclose a personal photo with his CV including the full name, phone number, email and P.O. Box, in addition to the bank account number in English (Name, Name of the Bank, Account Number and Swift Code) in order to allow sending him the due amount in case the article is published, in compliance with the Magazine’s financial system.

7. All Articles in the magazine necessarily reflect the views of their respective authors and do not oblige Khalifa International Date Palm Award.

8. Scientific subjects in the magazine are arranged according to technical considerations.

9. The Magazine welcomes readers from all the date palm lovers around the world, who contribute in deepening the knowledge and building a sustainable society.
<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>06</td>
<td>Nahayam Mubarak: We try to extend the scope of the spread of the Award all over the UAE</td>
<td>20</td>
</tr>
<tr>
<td>14</td>
<td>Khalifa Award Exhibits its Efforts in the 7th International Conference of the Scientific Journalists in Qatar</td>
<td>22</td>
</tr>
<tr>
<td>16</td>
<td>The Palm Tree in the Eyes of the World</td>
<td>24</td>
</tr>
<tr>
<td>18</td>
<td>Development of 1000 Microsatellite Markers Across the Date Palm (Phoenix dactylifera L.) Genome</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>Date Palm Cultivation and Dates Production In Iraq</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>Date Palm Development Mission of Atul Ltd. in India</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Cultivation of Phoenix dactylifera L. (Date Palm) for Combating Desertification and Enhanced Livelihood: Nacgrab R and D Focus</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>Exploring the Nigerian Date palm [Phoenix dactylifera] Germplasm for in vitro Callogenesis</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>Inefficiency in Market Profit Distribution Effected Date Palm Production in Yemen</td>
<td>64</td>
</tr>
</tbody>
</table>
Hamdan Bin Zayed Opens
Liwa Date Festival 2011

Under the Patronage of Mansour Bin Zayed
Under the patronage of H.H. Sheikh Mansour Bin Zayed Al Nahyan, Deputy Prime Minister, Minister of Presidential Affairs, the activities of Liwa Date Festival in its 7th year launched on the 12th of July 2011 amid a wide participation of more than 50 pavilions representing a number of governmental institutions and private companies and firms. A large number of tourists and visitors from inside and outside the State came to the festival organized by Abu Dhabi Authority for Culture & Heritage. HH. Sheikh Hamdan Bin Zayed Al Nahyan, Representative of the Ruler in the Western Region of Emirate of Abu Dhabi visited the sections of the festival in its first day and its various pavilions.

The festival, which is considered a unique carnival of heritage and tourism, includes a major contest, namely, Date Decoration Contest in addition to many other attractive events which were warmly welcomed by the visitors. These include the Folk Market which includes about 160 shops which display various hand-made industries derived from palm and date, besides a tent for children where the various heritage and folk contests took place. The festival witnessed as well the presentation of many heritage shows, popular games and holding cultural settings which aim at arousing awareness in the importance of the Emirati heritage throwing light in its most prominent features.
milestones in addition to the contest of Heritage Taste for Cooking.

On this occasion, HE. Mohammed Khalif Al Mazroui, Advisor for Cultural and Heritage Affairs at the Court of H.H the Crown-Prince, Director General of Abu Dhabi Authority for Culture and Heritage, Chairman of the Festival Higher Organizing Committee expressed his happiness for the launching of this eminent event which is considered the first of its kind in the region with regard to dates. The festival, moreover, constitutes as well an outstanding opportunity for the members of the family to enjoy the rich heritage activities the festival comprises.

HE. was fully satisfied with the great turnout witnessed by the festival, the organization, and the variety of participations and activities in this tourist and heritage demonstration which is unique of its kind. The festival as such comes as an execution of the strategy of Abu Dhabi Authority for Culture & Heritage to maintain the heritage of Abu Dhabi and the UAE, particularly the palm which occupies a big area of the genuine Emirati heritage and the human memory of the Emirati community.

Liwa Date Festival which is held on an area of 20,000 M2 constitutes a unique gathering place for lovers of palm and dates whether individuals or corporates. It is considered a family festival full of heritage activities of interest to all members of the family.
including a number of contests besides the Popular market.

**The Festival**

**Honorary Guests**

H.H. First Lit. General Sheikh Mohammad Bin Zayed Al Nahyan, Crown – Price of Abu Dhabi, Deputy of Supreme Commander of the Armed Forces asserted the importance of investment in the agricultural sector and the endeavor to develop and adopt the best practices conducive to improve the quality of agricultural products and enhancing their productivity. H.H praised the care of H.H Sheikh Kalifa Bin Zayed President of the UAE (May God Protect him) to provide the unlimited support to rise the agricultural sector and achieve its sustainability. This statement was given during H.H visit on the Eve of 19 July 2011 to Liwa Date Festival activities. Moreover, H.H called for activating partnerships in the area of agriculture and acting on encouraging the participation of the Private Sector, University Research Centre and scientific institutions to develop and boom the agriculture sector in a way that distinguishes the Emirates distinction in fruit crops making them capable of competition regionally and internationally, a step that contributes in supporting national economy.

H.H Sheikh Mansour Bin Zayed Al Nahyan, Deputy Prime Minister, Minister of Presidential Affairs made a tour to the festival activities on Wednesday the 13th of July 2011.

H.H Sheikh Tahnoon Al Nahyan, Reprehensive of the Ruler in the Eastern Region made a special visit to the festival on Wednesday the 20th of July 2011. He praised the unlimited support provided by H.H Sheikh Kalifa Bin Zayed, President of the UAE (May God Protect him), to the activities which throw light in the Emirati heritage trying for its revival in the minds of the coming generations.

H.H Sheikh Nahayan Mubarak Al Nahyan, Minister of Higher Education & Scientific Research paid a special visit to the Festival on the 20th of July 2011 wherein checking the festival activities and praising the exerted efforts to revive the heritage of fathers and ancestors.

H.H. Hamdan Bin Zayed Al Nahyan Representative of the Ruler in the Western Region praised the great success and sharp development which Liwa Date Festival is witnessing in the Western Region in its 7th year respectively. H.H asserted that the success that has been achieved by the festival is a good testimony to the true method followed by the late Sheikh Zayed Bin Sultan Al Nahyan (May God rest his soul) in spreading greenery and development in all parts of the country and the care given to the palm tree, the symbol of life and giving.

**The contest Categories:**

Al Dabbas and Akbar Azej categories, Al Khalas, Boumaan, Khnezi, Al Fard, the largest frond, mango and local lemon categories, the category of the most beautiful heritage show
Hamdan Bin Zayed Opens Liwa Date Festival 2011

The Judgment Committee evaluated the participations among all categories of the contest on the base of the quality of the date, its size, color and taste. Results are to be announced after checking the farms according to various criteria including the general cleanliness of the farm, care in the palm through proper pruning and maintaining its cleanliness, and using the best method of irrigation to save irrigation water, in addition to adherence of delivery dates samples as per the categories and the pre-determined dates.

Popular Heritage

The Popular market which comprises about 160 shops attracted great turnout where visitors and tourists went through it and watched heritage tools, hand-made products made of palm and dates, a scene that reflects the spirit of heritage which Liwa Date Festival is known for.

The Fine Arts Exhibition organized by the students of Fatima Bint Omran School in Ban Yas played an outstanding role in throwing light in the palm tree and its importance through the Verses in the Holy Quran that quoted the palm in addition to many paintings inspired by the nature of the sand and palm trees of the Western Region.
Creation of Delicious and tasty Dishes

Liwa Date Festival witnessed the creation of a delicious dish made from grilled camel meat, date and pineapples with date sauce and some pieces of sweet potato and lettuce. One of the chefs has created the delicious dish for the first time on the occasion of the festival. The said dish attracted the cooking experts at hotels. The creation of the dish came within the frame of the contest of “Heritage Taste for Cooking” which is held for four days during the festival. The Judgment Committee consisted of an elite group of experts and connoisseurs from international hotels.

Dogs for Detecting Palm weevil

The festival witnessed the demonstration of the trained dogs to detect the palm tree suffering from palm weevil. The dog smells the palm and sits near the infected palm tree. What is new this year according to the First Working Officer Ahmed Ali Al Darmaki, from Abu Dhabi Police Headquarters, is that dogs were trained to bark and point to the infected palm tree. He indicated that the idea comes from Al Foa Co. suggested to Abu Dhabi Police. Dogs were trained for 3-6 months to face different conditions. He added that the time for inspecting the farm...
shall be when the sky is clear, at low temperature and moderate wind, this is not to mention that the farm shall not be fertilized. He said the same idea would be spread later after obtaining the due approvals.

**Happy End**

Ten days passed and Liwa, situated at the Western Region of Abu Dhabi, is busy with the news of the palm attracting visitors who came to discover the world of dates and listen to the stories of this towering tree which grants the noblest fruit. There is always an end for each story. The end of the story of Date was beautiful this year where the festival witnessed brilliant success through daily details narrated by the ten days of the festival. There were the attractive and exciting contests such as the main contest “Date Decoration Contest” with its categories Al Dabbas and Akbar Azej categories, Al-Khalas, Boumaan, Khnezi, Al-Fard, the largest frond, mango and local lemon categories, the category of the most beautiful heritage show category, and the most beautiful date table, all of which distinguished the ancient local environment and its most prominent details.

On his part, Mr. Obaid Khalfan Al Mazroui member of the Higher Organizing committee, Director of Liwa Date Festival 2011, asserted that the festival this year witnessed an increase in its total area amounting to 20% in an attempt of the Festival Administration to enable the participating pavilions to increase their displayed items and accommodating a greater number of visitors. He indicated that the number of visitors exceeded 70,000 visitors, a number which is comparable to the percentage of last year. Moreover, the daily sale average was 250,000 AEDs.
During his Visit to Liwa Date Festival

Nahayan Mabarak praised of the plentiful product of dates

H.H Sheikh Nahayan Mabarak Al Nahayan, Minister of Higher Education & Scientific Research, President of the Board of Trustees of Khalifa International Date Palm Award praised the activities of Liwa Date Festival 2011 held under the patronage of H.H Sheikh Mansour Bin Zayed Al Nahyan, deputy Prime Minister, Minister of Presidential Affairs, organized by Abu Dhabi Authority for Culture and Heritage.

In a statement made after his tour to the activities of the festival , H.H said these heritage demonstrations which are held in the Western Region, the cradle of fathers and ancestors, come under the directives of H.H Sheikh Khalifa Bin Zayed, President of the UAE ( May God protect him ) to continue the process of welfare and giving which was established by the late H.H Sheikh Zayed Bin Sultan Al Nahyan ( God rest his soul ) and which
was supported by First Lt. General H.H. Sheikh Mohammad Bin Zayed Al Nahyan, Abu Dhabi Crown Prince, Deputy Supreme Commander of the Armed Forces, and the fellow-up of H.H. Sheikh Handan Bin Zayed Al Nahyan, Ruler’s representative in the Western Region which aims at encouraging and motivating heritage revival, to link the past with the present, and to give special care to the blessed palm tree.

H.H. Sheikh Nahayan Mabarak emphasized that the UAE comes first in rank in growing the biggest number of date palm trees at the level of the world, and it exports distinguished types of dates, describing dates as real food treasure which provides nutrition and honorable life to nationals. He admired the farmers’ interest and care to develop all aspects of farms, devoting special care and inserting good seedlings to get good output to provide food security.

H.H. Sheikh Nahayan accompanied by HE. Juma Al Majed, President of Dubai Economic Council, HE Ahmed Humaid Al Tayer, Governor of Dubai International Financial Centre, Obeid Khalfan Al Mizzroui, Festival Manager, Hasan Suheil Al Mizzroui, Director of Parks and Recreational Facilities at the Western Region Municipality, toured the festival activities through which he witnessed the two consents of Dates Decoration and the most beautiful heritage display besides visiting the participating pavilions. Moreover, he visited the folk market of handcrafts which aims at maintaining the spirit of the Emirati original heritage and had a look at the items made from palm, date seed and traditional heritage tools.
Nahayan Mabarak offers winners and participants 10000 tissue palm seedlings

Active Participation of Khalifa Award in Liwa Date Festival in its 7th session of 2011
H.H Sheikh Nahayan Mabarak Al Nahayan, Minister of Higher Education & Scientific Research, President of the Board of Trustees of Khalifa International Date Palm Award, gave 10,000 tissue palm seedlings as gift to winners and participants in Liwa Festival of Dates in its 7th session of 2011 which was organized by Abu Dhabi Authority for Culture and Heritage in an appreciation effort of His Highness to the lovers of date palm tree and winners of its award who worked hard and achieved the best results at the level of the competition various official categories. These seedlings are considered among the best types which are produced by the UAE university laboratory.

On this occasion H.H Sheikh Nahayan Mabarak Al Nahayan said “The growing of the Palm Date Tree in the UAE is considered an essential cornerstone in the process of sustainable development led by H.H Sheikh Khalifa Bin Zayed Al Nahyan, President of UAE (May God protect him) for its role in the equation of food security of our homeland where H.H realized what the importance of agricultural development represents in constituting real capital, and that is why he never hesitated to provide all means of support to rise and develop the growing of this tree, extend the grown area, achieve self-sufficiency and vary the means of income.

He praised as well the care of His Highness Sheikh Mohammad Bin Zayed, Crown – prince of Abu Dhabi, Deputy Supreme Commander of Armed Forces, President of the Executive Council of the Emirate of Abu Dhabi, given to the agricultural sector in general and the palm tree growing in particular since the agricultural policy occupies an important place in the conscience of H.H and reflects the special care which this policy gives to the blessed tree as a continuous step on the way of the late H.H Sheikh Zayed Bin Sultan Al Nahyan (God rest his soul) in taking care of the requirements of the Unique agricultural experiments on our homeland.

It is worthwhile mentioning the support of H.H Sheikh Mansour Bin Zayed Al Nahyan, Deputy Prime Minister, Minister of Presidential Affairs and his special care in the reality and future of the blessed tree at all levels and on all occasions particularly Khalifa International Date Palm Award.
The Turnout of Palm Tree Lovers and Date Producers to Participate in the Award Categories

Khalifa International Date Palm Award Witnessed Active participation in Liwa 7th Festival - 2011
Khalifa International Date Palm Award attracted the interest of palm tree lovers and date producers who participated in Liwa 7th Festival for Dates through the great turnout of obtaining candidacy forms and inquiry about the standard of nomination and the conditions of participation in the Award different categories. The Award participation in the festival comes within the framework of spreading awareness, encouraging national farmers and creating the competitive spirit among farmers and producers about the mechanism of participation in the Award five categories.

On the occasion of the Award Participation in Liwa Seventh Festival for dates 2011, Dr. Abdelouahhab Zaid, the Award Secretary General referred to the sublime sponsorship which the Award and the blessed tree have by H.H Sheikh Khalifa Bin Zayed Al Nahyan, UAE President (God protect him) and First Lt. General H.H Sheikh Mohammad Bin Zayed Al Nahyan, Crown-Prince of Abu Dhabi, Deputy of Supreme Commander of the Armed Forces, and H.H Mansour Bin Zayed Al Nahyan, Deputy Prime Minister, Minister of Presidential Affairs.

Dr. Zaid stressed the fact that there is qualitative development within the activities of the festival to help developing the date palm sector at the level of the country through developing the means of treatment with farmers and producers and through extending the scope of participation within the festival official competition categories.

He added that Khalifa International Date Palm Award through the instructions of H.H sheikh Nahayan Mabarak Al Nahyan, Minister of Higher Education & scientific Research, President of the Board of Trustees of the Award, gives great importance to encourage national farmers to participate in the Award activities in its various categories and provide them with all the facilities and technical possibilities to apply for the competition in its fourth session.

The Secretary General illustrates as well that Khalifa International Date Palm Award was established under the patronage of H.H Sheikh Khalifa Bin Zayed Al Nahyan, UAE President (God protect him) as per Federal Decree No.15 of 2007 on 20/ March/2007 in order to carry out studies and researches about date palm and its spread world wide in appreciation of those who made great contributions in this field whether individuals or institutions. This award is independent and neutral granted annually to scientists, outstanding producers, impressive personalities and institutions which contributed in the area of research and date palm development.

However, the Award has five categories, namely, the category of distinguished research and studies, the category of distinguished producers, the category of the best developmental project, the category of the best distinguished technology, and the category of the distinguished personality in the field of growing and producing date palm. For further information, you may contact the Award Secretariat General, Tel. 037832434, e-mail: KIDPA@uaeu.ac.ae
Khalifa International Date Palm Award participates in Liwa Ajman Date Festival

Nahayam Mabarak: We try to extend the scope of the spread of the Award all over the UAE

Under the directives of H.H Sheikh Nahayan Mabarak Al Nahayan, Minister of Higher Education & Scientific Research, President of the Board of Trustees of Khalifa International Date Palm Award, the Secretariat General of the Award participated in Liwa Ajman Date Festival in its first version 2011 which was opened by H.H Sheikh Ammar bin Humaid Al Nuaimi, Crown – Prince of Ajman, President of the Executive Council, among a large Crowd of participants, farmers and interested people from all northern Emirates and with a special care of H.H Humaid Bin Rashid Al Nuaimi, member of the Supreme Council, Ruler of Ajman.

The Award participation aims at enhancing awareness in the importance of national participation
among dates farmers and producers in the UAE by distributing participation form within the five categories of the Award in its fourth session to the fellow citizens owners of the farms in the Northern Emirates.

Dr. Abdulwhab Zaid the Secretary General of the Award said that the Award participation comes in response to the invitation by the organizing committee of the festival in its first version in Ajman to the Secretariat General. The festival was organized by the Department of Culture & Media in Ajman in cooperation with Abu Dhabi Authority for Culture & Heritage on the festival ground during the period 27-29 July 2011. He affirmed the importance of this participation in response to the directives of H.H Sheikh Nahayan Mubarak Al Nahayan, Minister of Higher Education & Scientific Research, President of the Board of Trustees of Khalifa International Date Palm Award to enhance the national participation and extending the scope of the spread of the Award all over the UAE since it is the first time when the Award Administration communicates with palm trees farmers and date producers in the Northern Emirates. However, supervisors of the award pavilion were so careful to meet all the farmers demands and answer their questions and inquires related to the Award by the festival visitors, referring that the aim of the participation in the festival is to spread awareness and encourage national farmers creating a spirit of competition among them about the mechanism of participating in the five categories of the Award.

It is worthy to note in this connection that the Award opened candidacy to participate in the Award five categories on the first of last July and to end on the 30th of next October. The Award total value is more than 2 million & 300,000 AEDS, and it is considered the first and biggest award of its kind as a specialized award world-wide.
Khalifa Award Exhibits its Efforts in the 7th International Conference of the Scientific Journalists in Qatar

The Secretariat General of Khalifa International Date Palm Award participated in a paper within the activities of the 7th International Conference of Scientific Journalism hosted by the Qatari capital, Doha during the period 27-29 June 2011. The history of the Award was reviewed since its establishment by virtue of the Presidential Decree No.(15) of 2007 issued H.H Sheikh Khalifa Bin Zayed Al Nahyan, UAE President (May God protect him) passing through its four sessions and the wonderful results which The Secretariat General of the Award achieved at the local, regional and international levels thanks to instructions and support of H.H Sheikh Nahayan Mabarak Al Nahayan, Minister of Higher Education & Scientific Research, President of the Board of Trustees.

The paper talked about the great role played by the First Lit General, H.H Mohammad Bin Zayed Al Nahyan, Crown Prince of Abu Dhabi, Deputy of the Supreme Commander of the Armed Forces, and the efforts of H.H Sheikh Mansour Bin Zayed Al Nahyan Deputy Prime Minister, Minister of Presidential Affairs, in supporting the Award and the future of growing the date palm tree throughout UAE.

Dr. Abdelouahhab Zaid, the General Secretary of the Award illustrated that this participation came within the frame of the strategic plan approved by the Secretariat General to introduce...
the Award and to encourage the specialized categories to participate within its various categories since the campaign shall include in its Arab frame for this year Tunisia, Algeria, Egypt, and the Sudan.

Engineer Emad Saad, Head of the Media Committee of the Award, Member of the Arab Association of Scientific Journalists referred while presenting the paper, to the standards and conditions of the Award five categories and the mechanism of applying and the services provided by the General Secretariat to facilitate the participation of the palm tree lovers, researchers and producers from all parts of the world. He went through the names of the winners within the Award categories in its last three sessions. Award printed materials and registration forms were distributed to the scientific personalities participating in conference activities.

It is to be mention herein that the number of participants in the activities of the 7th conference of scientific journalists was about 600 journalists representing 90 countries world wide of whom there were 60 Arab journalists from all over the world, in addition to a number of the eminent scientific personalities at the top of whom is Dr. Ahmed Zowail, Nobel Prize Winner in chemistry who opened the conference.

The conference session of this year is considered the most important for Arab Scientific Journalists because the conference is held on an Arab land and hosted by the Arab Association of Scientific Journalists in cooperation with its partners the American Association of Scientific Writers and the Establishment of Qatar.

For further information, please contact Tel. 037832434, the Award Secretariat General and e-mail: KIDPA@uae.ac.ae
"The Palm Tree in the Eyes of the World"

An International Competition of Photography In Its 3rd Session -2012

The Competition Contributes in Enriching Our Homeland Memorial and Reviving Its Environmental Heritage

Under the patronage of H.H Sheikh Nahayan Mabarak Al Nahayan, Minister of Higher Education & Scientific Research, President of the Trustees Board of Khalifa International Date Palm Award, the Award General Secretariat announced the opening of participation in the international competition which is unique of its kind to photograph the date palm tree with all of its dimensions, products, tools, conditions and derivatives. The competition will be under the title: 'The Palm Tree in the Eyes of the World' and will be held in cooperation with Abu Dhabi Association for Photography. All lovers of photography world-wide, professional and amateur, are invited to contribute to this international competition in an appreciation of the Palm Tree and to reinforce the photographer's lens to enrich the memorial of our homeland and revive its environmental heritage.

The above was announced in a press declaration by Dr. Abdelouahhab Zaid, the Award General Secretariat on the occasion of launching the third version of the competition stressing at the same time the great success achieved by the competition in its previous session through the noticeable increase in the number of participants coming from all over the world and the quality of the participated photos.

He added that this competition came as a result of the directives of H.H Sheikh Nahayan Mabarak Al Nahayan, Minister of Higher Education & Scientific Research, President of the Trustees Board of Khalifa International Date Palm Award in enhancing the relation between man and the Palm.
tree and his unlimited support to the blessed tree by exploiting the art of photography as a means to develop the public awareness of the importance of the date palm tree so as to create wider spaces to exchange experiences among photographers world-wide in addition to displaying the tourist, environmental and heritage features of the date palm tree via the photo and finally to promote man’s relation with the land and agriculture.

As for the prizes of the Award, the Secretary General of the Award mentioned that the first winner will get 5000 $, the second 4000 $, and the third 3000 $, in addition to certificates of appreciation and memorial shields.

A specialized technical committee will judge the participated works, sort the results and announce the winners’ names during February with a special celebration of the winning and distinguished works under the patronage of H.H daughter of Sheikh Nahayan Mabarak Al Nahayan, Minister of Higher Education & Scientific Research, President of the Trustees Board.

On his part, his Excellency Abdullah Salem Al Amri, Director of Culture & Arts Department at Abu Dhabi Authority for Culture, expressed his pleasure for the fruitful cooperation with the General Secretariat of Khalifa International Date Palm Award in launching this competition specialized in the date palm tree and his care to increase cooperation between the authority and the Award so as to enhance the sincere relation with the palm tree and to throw light on the industries of heritage which depend on parts of the palm tree such as the palm leaves or fronds.

As far as the technical conditions of the competition are concerned, he mentioned that the competition is open for all professional & amateur photographers world-wide, and that the deadline for submitting participations is 31/Dec/2011. However, results shall be announced during a celebration of the winners in the third session of the competition, Feb.2012. It is likely possible for lovers of palm-tree and photography, professional & amateur, who are willing to participate in the competition to visit the website of Khalifa International Date Palm Award (www.kidpa.ae) or the website of Abu Dhabi Association for Photography (www.adaps.ae) or any other website specialized in photography whether in Arabic or English world-wide and fill in the application form and have further information about the technical conditions.
Development of 1000 Microsatellite Markers Across the Date Palm (Phoenix dactylifera L.) Genome

Aladdin Hamwieh¹, Jack Farah², Sobhy Moussally², Khaled Al-Sham‘aa³, Khaled Almer³, Hussam khierallah⁴, Sripada Udupa⁵, Samer Lababidi³, Joel Malek⁵, Mohamad Aaouine³, and Michael Baum¹

Abstract
Date Palm is a major environmental and economic factor in arid climates in many countries around the world. Microsatellite markers have been proven to be very powerful in plant genome analysis because they are locus-specific, codominant, highly polymorphic and highly reproducible. In date palm only few microsatellite markers have been developed so far. Recently, the Cornell Medical College in Qatar issued a draft assembly of the date palm genome (Khalas) generated by whole genome shotgun next generation DNA sequencing. In this paper, we analyzed the microsatellite motifs across the date palm genome. The results indicated that the most abundant type of microsatellite repeats are dinucleotide repeats (52442 motifs) followed by trinucleotide (28503 motifs) and pentanucleotide repeats (12873 motifs). The frequencies of tetra-nucleotide and hexa-nucleotide repeats were less across the genome (5555 and 5810 motifs, respectively). The most common type of dinucleotide repeat was GA (48.7%) followed by AT (37%). Out of 28645 trinucleotide repeats, TAA and GAA repeats were the most abundant repeats (28.1% and 27.11%) respectively. More than 1090 new microsatellite markers could be designed. The primarily test for 50 primer pairs revealed that 28 (56 %) were functional and 19 (38%) yielded polymorphic PCR products. We wish that the results of our study will be a starting point for researchers making use of the markers for genetic mapping and diversity analysis of date palm.

Keywords: P. dactylifera, microsatellite marker, simple sequence repeats, adh gene.
**Introduction**

Date palm (Phoenix dactylifera L, \(2n=2x=36\)), is a dioecious perennial monocotyledon fruit plant from the Arecaceae family. The predicted genome size was estimated to be approximately 250Mbp (Barakat et al., 1999). The origin of this tree is Iraq, and recently, thousands of cultivars have been reported (Hanachi et al., 1998). Date palms have always been clonally propagated to ensure the identity and uniformity of the cultivars.

Discrimination among closely related cultivars by using morphological traits (including fruit morphology) are often unreliable and extremely difficult, especially because of the influence of environmental conditions (Elhoumaizi et al., 2002). Therefore, the need for using DNA marker technology for DNA fingerprinting has become increasingly important in recent years. Several marker systems have been used to study the genetic diversity of date palm, in brief, randomly amplified polymorphic DNA (RAPD) fingerprints have been used to identify date palm accessions in Algeria (Benkhalifa, 1999), in Morocco (Sedra et al., 1998), in Tunisia (Trifi et al., 2000), in Saudi Arabia (Al-Khalifah and Askari, 2003), and in Egypt (Soliman et al., 2003; Adawy et al., 2006). Amplified fragment length polymorphic (AFLP) markers have been applied to study the polymorphisms of date palm cultivars from Egypt and California (Cao and Chao, 2002; El-Assar et al., 2005; Adawy et al., 2006). Microsatellite or simple sequence repeat (SSR) markers have been used in plant diversity analysis because they are locus-specific, codominant, highly polymorphic and highly reproducible. Microsatellite markers have been developed and used to investigate genetic diversity in P. dactylifera (Billotte et al., 2004). They used (GA)n microsatellite-enriched library to develop 16 microsatellite markers. More recently, 17 microsatellite loci were developed by constructing two microsatellite enriched libraries of date palm by using (GA)n and (GT)n repeats (Akkak et al., 2009). These microsatellite markers have been used to assess the genetic diversity and relationships of date palm varieties in Tunisia (Zehdi et al., 2004), in Sudan (Elshibi and Korpelainen, 2007), in Oman (Al-Ruqaish et al., 2008), and in Qatar (Ahmed and Al-Qaradawi, 2009). However, for a wider use of microsatellite markers evaluating DNA polymorphisms in date palm tree, the development of hundreds of microsatellite markers would be necessary.

Unlocking the date palm occurred in April 2009, when researchers in the Weill Cornell Medical College in Qatar (WCMC-Q) used the variety named ‘Khalas’ (one of the most popular varieties of the fruit) to issue an assembly draft of the date palm genome generated by whole genome shotgun next generation DNA sequencing. The available sequence is a start point to apply advanced genomic technologies to a better understanding of date palm genome. The objective of this research was to study the frequency of microsatellite motifs across the date palm genome, and to develop new microsatellite markers.

**MATERIAL AND METHODS**

**Sequence analysis**

The multi-fasta file of date palm sequence issued by WCMC-Q was downloaded from this web site address: http://qatar-weill.cornell.edu/research/datepalmGenome/download.html. The sequence file is named as (PdactyKAssembly1.0.fasta – 329328 KB) and contained 271804 fasta sequence clones.

**Isolation of microsatellites**

The microsatellite motifs were classified as perfect, imperfect, compound perfect, or compound imperfect repeats according to
A microsatellite is referred as 'simple', if a single type of repeat unit repeats several times (e.g., (CA)n; etc.); a 'compound' microsatellite consists of stretches of more than one type of repeat unit (e.g., (GA)n·(TA)k; (GT)k·(TAA)l·(TA)m, etc.); a 'perfect' microsatellite does not contain mutations or interruptions (e.g., (CA)n; (TAA)k; (CT)m·(GAA)n, etc.); an 'imperfect' microsatellite contains mutations or interruptions (e.g., (CA)nCC(CA)m; (TA)kAA(TA)l·(GA)m, etc.). Subscripts k, l, n and m denote number of times the particular microsatellite motif repeats.

Short script was written by us in Perl software to collect the microsatellite motifs from the assembly draft of the date palm genome and categorize them as di-, tri-, tetra-, penta-, and hexa- nucleotide repeats. The percentage of accepted non-repeated nucleotides within the microsatellite motifs was fixed between 10-20% and called as error rate. For instance, in the following trinucleotide microsatellite (TTA)₃ –CAC – (TTA)₃ – GAC – (TTA)₄ – CCGG – (TTA)₃, consisted of 50 nucleotides, whereas ten (20%) nucleotides are not repeated sequence. However, only 10% of error rate were selected for further analysis in this study.

**Plant material**

A total of 30 well-defined reference Iraqi date palm varieties were collected from two date palm stations belonging to the Ministry of Agriculture in Baghdad, Iraq. These female varieties are: Ashrasi, Barhi, Bream, Chipchab, Gunter, Helawi, Jamal Al-Dean, and Khedrawi. Total cellular DNA was extracted from young and healthy leaves as described by Rogers and Bendich (1985) with minor modifications. After purification, the obtained DNA was quantified and its integrity checked by using agarose gel electrophoresis (1%).

**Primer design and PCR amplification of microsatellites**

Primer pairs were designed close to the microsatellite repeats in the flanking regions by using Primer3 v. 0.4.0 web base application available at this site address (http://frodo.wi.mit.edu/primer3/). The expected product size was limited to 200 bp, the length of the primers varied between 18 and 23 bases, the melting temperature (Tm) is fixed to be around 60 °C, and all other parameters were kept as default values without change.

The PCR reactions were performed in a total reaction mixture of 20 µl containing: 50 ng of total cellular DNA (2 µl) as template, 1X PCR buffer (Roche, Manheim Germany), 0.2 mM of dNTP PCR mix (Roche), 0.5 U of Taq DNA polymerase (Roche) and 10 pmol of each primers (forward and reverse primers). Amplifications were performed in a Applied Biosystem Thermocycler (Applied Biosystem) with the following conditions: a denaturation step of 5 min at 95 °C
followed by 35 cycles of 15 s at 95 °C, 15 s at 58 °C and 30 s at 72 °C, and a final extension step at 72 °C for 5 min. Amplification products was separated on 8% polyacrylamide gels stained by ethidium bromide. The DNA banding patterns were visualized on an UV transilluminator and documented by using Gel Documentation System (Alpha Innotech).

RESULTS AND DISCUSSIONS

Microsatellite motifs

The assembly draft of the date palm genome was analyzed and screened for microsatellites motifs using a script in Perl software (supplemented date). The results indicated that the draft sequence of date palm consisted of 321,278,327 bases including 94,386,304 adenine “A”, 57,044,647 cytosine “C”, 57,187,022 guanine “G”, 94,100,785 thymine “T”, and 18,559,569 unspecified nucleotides “N” (Table 1). Microsatellite motifs varied according to the three error rates (10, 15, 20%), less error rate showed less microsatellite motifs counted (Figure 1). However, we used a 10% error rate in this study to increase the efficiency of microsatellite assessment.

Microsatellite motifs were frequently identified across the genome in about 105,183 microsatellite motifs (approximately one microsatellite per 3054.5 bases). Most of the repeats in date palm were of the simple/imperfect type (55,425 motifs) comparing to the simple/perfect (48,868 motifs). In contrast, many studies of plant species reported simple/perfect motifs to be the most abundant repeats in Brassica napus L. (Kresovich et al., 1995), in chickpea (Cicer arietinum L.) (Hüttel et al., 1999; Winter et al., 1999), and in lentil (Hamwieh et al., 2009). Among the microsatellite repeats, dinucleotide were the most abundant repeats across the date palm genome (52,442 motifs) followed by trinucleotide repeats (28,503 motifs) (Table 1). The most abundant repeat type in date palm genome was AG/TC (25,903 motifs) followed by GT/AC (20,160 motifs) then AC/TC (6,756 motifs).

Billotte et al. (2004) developed 16 microsatellite primers from (GA)n microsatellite-enriched library by using GA. Later, Akkak et al. (2009) developed 17 microsatellite primers from two enriched library by using (GA)n and (GT)n repeats. Approximately 94.1 % of their microsatellite motifs published were identified by the (GA)n library. This supports our finding that GA is the predominant repeat across date palm genome. However, the GT repeat is one of the most frequently occurring microsatellites in human and many mammals (Toth et al. 2000). This is also the case in some plant species, such as wheat (Varshney et al. 2000) and Pinus radiata (Smith and Devey, 1994), but this repeat (GT) is comparatively less frequent in

<table>
<thead>
<tr>
<th>Nucleotide</th>
<th>Count</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenine(A)</td>
<td>94,386,304</td>
<td>0.294</td>
</tr>
<tr>
<td>Cytosine(C)</td>
<td>57,044,647</td>
<td>0.178</td>
</tr>
<tr>
<td>Guanine(G)</td>
<td>57,187,022</td>
<td>0.178</td>
</tr>
<tr>
<td>Thymine(T)</td>
<td>94,100,785</td>
<td>0.293</td>
</tr>
<tr>
<td>Unspecific (N)</td>
<td>18,559,569</td>
<td>0.058</td>
</tr>
<tr>
<td>C+G</td>
<td>114,231,669</td>
<td>0.356</td>
</tr>
<tr>
<td>A+T</td>
<td>188,487,089</td>
<td>0.587</td>
</tr>
</tbody>
</table>

Table 1. The number of the nucleotides and its frequency within the date palm genome.
Development of microsatellite markers

In total 1091 primer pairs could be designed in the flanking regions of simple/perfect microsatellite motifs. The expected sizes of these primers ranged between 113 and 345 bp with an average of 208 bp. Out of these primer combinations, 377 flanked dinucleotide, 352 primer pairs flanked trinucleotide, and 362 primer pairs flanked tetranucleotide repeats. Out

Table 4. Forward and reverse primer sequences of the primers revealed polymorphic loci in mini core collection of Iraqi date palm varieties

<table>
<thead>
<tr>
<th>Reference</th>
<th>Primes</th>
<th>Clone number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Billotte et al. 2004</td>
<td>mPdCIR010 &gt;PdactyK1.0Scaffold_271028_length_2103</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mPdCIR025 &gt;PdactyK1.0Scaffold_375496_length_3618</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mPdCIR032 &gt;PdactyK1.0Scaffold_952984_length_2335</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mPdCIR050 &gt;PdactyK1.0Scaffold_1723771_length_10937</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mPdCIR057 &gt;PdactyK1.0Scaffold_1698674_length_1883</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mPdCIR070 &gt;PdactyK1.0Scaffold_961639_length_1935</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mPdCIR078 &gt;PdactyK1.0Scaffold_36821_length_10487</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mPdCIR085 &gt;PdactyK1.0Scaffold_108495_length_3573</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mPdCIR090 &gt;PdactyK1.0Scaffold_830856_length_5891</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mPdCIR093 &gt;PdactyK1.0Scaffold_1742274_length_2028</td>
<td></td>
</tr>
<tr>
<td>Akkak et al. 2009</td>
<td>PDCAT10 &gt;PdactyK1.0Scaffold_1871877_length_11760</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PDCAT11 &gt;PdactyK1.0Scaffold_332319_length_10772</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PDCAT14 &gt;PdactyK1.0Scaffold_1406391_length_898</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PDCAT15 &gt;PdactyK1.0Scaffold_1377333_length_946</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PDCAT17 &gt;PdactyK1.0Scaffold_1077978_length_376</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PDCAT18 &gt;PdactyK1.0Scaffold_1165340_length_2957</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PDCAT1 &gt;PdactyK1.0Scaffold_1498949_length_13938</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PDCAT20 &gt;PdactyK1.0Scaffold_317589_length_3777</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PDCAT21 &gt;PdactyK1.0Scaffold_836398_length_3971</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PDCAT3 &gt;PdactyK1.0Scaffold_1661598_length_4767</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PDCAT6 &gt;PdactyK1.0Scaffold_1657267_length_1165</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PDCAT8 &gt;PdactyK1.0Scaffold_1541464_length_3258</td>
<td></td>
</tr>
</tbody>
</table>

Finally, less compound microsatellites were detected across the genome, included 702 dinucleotide motifs and 141 trinucleotide motifs.

Development of microsatellite markers

In total 1091 primer pairs could be designed in the flanking regions of simple/perfect microsatellite motifs. The expected sizes of these primers ranged between 113 and 345 bp with an average of 208 bp. Out of these primer combinations, 377 flanked dinucleotide, 352 primer pairs flanked trinucleotide, and 362 primer pairs flanked tetranucleotide repeats. Out
of 33 published microsatellite primers only 22 (10 out of 16 microsatellite primers published by Billotte et al., 2004, and 12 out of 17 primers published by Akkak et al., 2009) could be detected in the sequence (Table 3).

To estimate the functional capacity of these primers, 50 primer pairs were tested with 8 Iraqi date palm varieties. The results revealed that 28 primers combinations were functional (56%) and 18 (36%) revealed polymorphic alleles (Table 4). If we extrapolate these results we would expect to obtain out of the 1091 primers at least 350 polymorphic microsatellite across the date palm genome. Certainly, these new co-dominant markers will be a starting point for researchers making use of the markers for genetic mapping and diversity analysis of date palm.

It is important to mention that clone number (>PdactyK1.0Scaffold_1817710_length_7070C) showed 91% similarity to the washingtonia robusta alcohol dehydrogenase (adh) gene, (reference number on NCBI is: U65972.1). This microsatellite motif can be found under DPALM1091 (in the supplementary file). The adh gene was reported previously as the genetic basis for sex determination in date palm (Rajendran and Al-Mssallem, 2007). They yielded two clear bands of 800 bp and 1000 bp for the female genotypes and a single fragment of approximately 800 bp in male genotypes. In this study, we identified one microsatellite motif (ATG)2(AT)3C(ATG)(AT)3 which is located 158 bases away from the adh gene. It need to be tested if derived microsatellite markers could be used to screen for sex.

References


Date Palm Cultivation and Dates Production In Iraq

Introduction

The date palm is a blessing tree, where it has been mentioned in all holy books (Twarat, Bible, and Holy Quran). Babylonians named date palm as (Jishimmaru), which was taken from a Sumerian word (Jishimmar). In Sumerian language it is called (Zulumma), in Hebrew language (Tamar), Aramean (Dqla), in Habishia (guineahen) called (Tamart), in Hieroglyphic (BNR or BNRT), which means sweetness, in Indian language (Kharma) and this is quoted from Persian. The Grecian name (Phoenix) is derived from Phoenicia, where the Phoenicians owned date palm and they spread its cultivation in Mediterranean Sea. Dactyls, is derived from Hebrew Dachel which means fingers.

Abo Hanifah Aldinory mentioned in his book (Plant Book) that every unknown date is called (Dachel),
which in the name Iraqi people called to the seeded date palm.

The exact origin of the date palm (Phoenix dactylifera L.) is still unknown yet because wild date palm from which cultivated palm was developed has never been found. One of the researchers like Albaker (1972) mentioned that date palm developed from a genetic mutant in Phoenix canarensis and developed by the natural hybridization between different species of date palm. Another opinion mentioned that the origin is Phoenix reclinata from tropical Africa or Phoenix sylvestris from India or a hybrid between these two species may be the origin of date palm (Zaid,1999). All the species which belong to genus (Phoenix) have similar characteristics, but they still far from each other in many other properties that we can’t consider any of them as an origin of the other. All these opinions still need scientific and historical documentation.

**Date palm classification**

The family name Palmae was changed to Arecaceae in corresponding to big genus (Areca), and the previous name without (aceae). This family includes 200 genera and 4000 species. The most commercial important genus are:

1. Phoenix: It is the genus to which the species date palm (Phoenix dactylifera L.) does belong.
2. Cocos: It is the genus to which the species coconut palm (Cocos nucifera L.) belongs.
3. Elaies: It is the genus to which the species Oil palm (Elaeis guineensis L.) belongs.
4. Washington: It is the genus to which the species Whashingtonia palm (Whashingtonia filifera) belongs.

**Date palm is classified as follows:**

- **Kingdom:** plant
- **Phylum:** Anthophyta
- **Class:** Angiospermae
- **Subclass:** Monocotyledanae
- **Order:** Phalaenae
- **Family:** Araceaeae (palmae)
- **Genus:** Phoenix
- **Species:** dactylifera L.

The botanical name of the date palm as the binomial system is (Phoenix dactylifera L), with time, many physiological, morphological and genetic changes happened, which required to be differentiated and classified under variety concept, but this phrase is a general botanical expression which includes wild and cultivated varieties. In order to differentiate between the commercial and cultivated varieties, they were called cultivars, which is derived from (cultivated variety) and may be correlated to the name of the region or person in which it was found, and it can be abbreviated by (C.V). So the binomial scientific name of the variety Halawii is (Phoenix dactylifera L. cv. Hillawi).

Sometimes individuals of date palm cultivars appear showing different characteristics than the original cultivar and when these new characteristics are constant and transferred genetically by vegetative propagation then the new trees are called (clone).

In Iraq there are three clones known as Khadrawi cultivars (Khadrawi Basra, Khadrawi Baghdad, and Khadrawi Mandli) and these clones differ in the fruit size only. Also there are two clones for the (Deglet Noor cultivar), and the only difference between them is that the first one is early ripening, and the second is late-maturing clone (Hayani). An Egyptian cultivar has two clones differ in fruit size only, (Ghanami) the Iraqi male cultivar has two clones (Ghanami Akhdar “green”, Ghanami ahmar “red”), and they differ in the spadix color and size.

**Date palm characteristics over other fruit trees:**

It is a monocotyledon tree, in spite of the absence of cambium, the cylindrical trunk is huge due to the growth of apical apex and enlargement of leaf bases. The trunk is strong, flexible and wind resistant, because of the air passages in the trunk and due to the penetration of roots deep in soil taking a tent shape.
The age of date palm leaf (Sa’afa) is six years after that leaves activity will stop, losing chlorophyll pigment and dried up, but they don’t fall down due to the lack of abscission zone. It should be cut by man. The arrangement of leaves at the tree head called phylatoxy, the leaves are alternatively arranged up to 13 leaves to avoid over shading. Palm tree can’t grow well in shady areas because leaves require high light intensity for photosynthesis, therefore areas of low light intensity are not suitable for palm tree cultivation.

There is no root hairs on date palm root system, the tree capable of forming adventitious roots on the trunk, the roots have exceptional ability to exclude the harmful ions (Na+, Cl-) and highly control absorption of these ions from the saline soil solution and irrigation water, and also tolerate water logging for a longer periods, because of air passages, extending from the roots through the trunk, to the leaves, stomata which facilitate its respiration.

Date palm trees are tolerant to high and low temperatures, where it can tolerate chilling stress (down to -6°C). The optimum temperature for leaf growth is 10°C, flowering is 18°C and 25°C for fruit setting.

The apical apex is enclosed with leaf bases and fibers which protect it from temperature fluctuations. The apical dominance is obvious in date palm tree, and the trunk is rarely branched, especially in (Taberzal cv.), cutting apical apex usually leads to death.

**Origin of date palm:**

Date palm is probably the most ancient cultivated tree in the world, researches and studies differed about the origin of the date palm but the confirmed thing is that it was famous in all the Arab civilization and it is still known as the most important Arabian tree.

Odardo Beccari an Italian specialist in palmae (Aracaeae) mentioned that the Arab Gulf is the origin of date palm, he referred to a palm genus which lives mainly in sub-tropical region where the rainfall is very rare, and its roots require high soil moisture, and it is tolerant to salinity. These properties are found in west India, Southern Iran, and Arabian Gulf coasts.

Decandoll, a French scientist mentioned that date palm aroused since before history in the semi-arid region, which is located between 10, 35°latitude North of Equator.

Many historians mentioned that date palm was cultivated as early as 4000 B.C in Mesopotamia in Babylon and Ur, other historical studies indicated that first origin of date palm is the southern part of the Arab peninsula-Yemen, Bahrain (Delmon land), the southern of Iraq, and Almadinah Almounorah.

Sayce translated some of the archeological texts about date palm saying (The holy tree with the leaves reaching the sky and roots getting so deep, it is the tree people depend on in their living, it is truly the tree of life, and this was shown in Babel and Ashur temples.

It has been found in the Arab and Iraqi historical places so many signs about date palm.

The first documented appearance of date palm tree in the old world was in the archeological sites: Tal Awooili and Tal Abo Shahreen in the Arido (Awr) city in the extreme south of Iraq, 4000 B.C., where many Samarian symbols were discovered indicating that date palm was dominate there long time ago.

The story of Adam and Eve and the forbidden tree was discovered in the ruins of the Samarian civilization dated back to 2700 year B.C., they found a board contains a man drawing, on his head a two-horn cap and uncovered...
woman sitting and between the a date palm tree, with two fruit bunches, the right hand of the man was touching the first bunch and left hand of the woman picking up a date fruit from the second bunch, and there was a standing snake behind the woman pushing and encouraging her to have from the forbidden tree.

There is in the Iraqi museum (Bagdad) a stamp/seal belongs to the Acadians age (2730 B.C.) contains two men between the a date palm tree.

Ashoreen in Iraq were worshiping four things (Plough implement, winged ox, holy tree, and date palm tree), the date palm tree was found drawn on a crown was placed on the top of a worship corner belongs to the age of Aserhadoon (669 – 680 B.C.).

A Sumerian board was discovered belongs to the age of the king Shoosen from the third Sumerians race (70 – 78 B.C.) contains a full description of a palm orchard belong to the temple of the God of Oma city, the board was divided into 8 divisions each one represents a variety of the different cultivated varieties, and the age of the fruitful and non-fruitful date palm trees was mentioned, in addition to the yield of tree.

Hammurabi the sixth king of the Babylon race, who ruled for more than 42 years (1750 – 1792 B.C.) who formulated the first legislation in the history, which is known by his name, includes 7 points related date palm tree, which are:

Item (59): assured the importance of protection of the date palm tree, where a fine of 225 g of silver was imposed for cutting of a date palm tree.

Item (60): Regulated the issues of cultivation, and the relationship between landlord and beneficiary, saying that the orchard caretaker has to plant the land with the offshoots and take care of them for 4 years, and in the fifth year he will divide the yield fifty fifty between him and the landlord.

Item (64): Third of the date will go the person who is pollinating the trees, and take care of them.

Item (65): The beneficiary should properly take care of the orchard, and he has to compensate the landlord if the yield was low due to his carelessness.

The pollination of date palm trees is considered as one of the religious yew during the period of Babylons and Sumerians.

Babylons were preparing a drink from the sap of the date palm tree, called “the drink of life”, and got so many benefits estimated by 365, which was included in the Babylon poem, and 800 benefits which was found written in the ancient Palmyra song.

Date palm tree is one of the most ancient trees known by the people of Bahrain, goes back to 4000 years B.C.

Two coaly date palm bulbs were found in the Delma Island of Abu Dabi, the studies assured that they belong to 4670 - 5110 years B.C.. Date palm bulbs were also discovered in the Hail site, in Al-Ain city (2900 B.C.), and Tal Abrak between the Sharqa and Om Kwaiin (2200 B.C.). These discoveries assure that the United Arab Emirates is the oldest consumer of dates.
Date palm cultivation and dates production in Iraq

Location of date palm cultivation in Iraq:
Date palm cultivation in Iraq is concentrated in the area between Mandli and Tikrit, which is located in 35° South. Its cultivation is distributed in 13 Governorates (Basrah, Baghdad, Missan, Wasit, Thiqar, Muthna, Qadissia, Najaf, Karbala, Anbar, Diala, Salahaldin) as shown in the following table:

<table>
<thead>
<tr>
<th>Governate</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basra</td>
<td>Dair, Ahattalarab, Hartha, Mudina, AQurnah, Abu Alkhasib.</td>
</tr>
<tr>
<td>Thiqar</td>
<td>Nasria, Grai, Jibaish, Sokalshiukh</td>
</tr>
<tr>
<td>Wasit</td>
<td>Kut, Suiria, Azizia, Badra</td>
</tr>
<tr>
<td>Baghdad</td>
<td>Kradh, Kadmia, Yousifia, Abughari</td>
</tr>
<tr>
<td>Diala</td>
<td>Baquba, Khalis, Mandli, Khankin</td>
</tr>
<tr>
<td>Babyl</td>
<td>Hilla, Hindia, Alexandria</td>
</tr>
<tr>
<td>Anbar</td>
<td>Hiat, Rawh, Anah, Ramadi</td>
</tr>
</tbody>
</table>

Methods and systems of date palm cultivation:
Basrah Governorate:
Date palm cultivation in Basrah is a special method due to many factors:

- Date palm orchards on Shatt Al-Arab River are daily twice irrigated by tide, and this is a natural feature which doesn't exist in any other date producing country.
- Availability of the suitable temperature for the ripening of all palm cultivars.
- Lack of summer rainfall during ripening season.
- Cultivation of fruit trees and vegetables under date palm trees.

Other regions:
Cultivation in other locations is characterized by the condensed system and wide system, citrus and stone fruit trees are always cultivated under date palm trees, which is dominant in Baghdad, Diala, Karbala, and babyl, while in other governorates vegetables and forage crops are cultivated under date palm.

Intercropping cultivation:
The spaces between date palm trees cultivated with different field crops, vegetables, fruit trees, this depend on the orchard soil texture, water table, salinity level in water and soil and method of trees or offshoots cultivation. In saline soils, barey, alfalfa can be cultivated in the first years to amend the soil, after that vegetables, grape, pomegranate, peach, prunus, due to their early fruiting; all these trees can be cultivated at the same time with offshoots and when these trees reach ten years we can remove them to avoid soil degradation. Other fruit trees can be cultivated like (Citrus, Mango, Banana) as in Iraqi orchard system. In Basra Governorate, Ibrahim et.al (2001) indicated that different fruit trees and crops cultivated in date palm orchards, the fruit trees (Grape, Pomegranate, Zizyphus, Mango, Fig, Banana). The most cultivated trees are Zizyphus (43%), Grape (21.8%), Pomegranate (20.6%), Fig (8.1), and...
also vegetables are cultivated in the orchards, leaf crops (54.1%) Okra (19.2%), Cucumber (17.8%), Tomato (8.9%).

**Benefits of the intercropping cultivation:**
- Utilization of spaces between date palm trees by cultivation of crops or and fast-growing trees, which generate another source of income.
- Date palm trees use the water from the irrigation of the other crops and fruit trees.
- The residues of vegetables and crops improve soil and increase organic matter.
- Date palm trees benefit from cultural practices (hoeing, weeding) applied for the other intercropped plants, facilitating the root growth.

**Date palm production:**
Date palm production in Iraq fluctuates from year to another according to commercial date palm cultivars (Zahdi, Khistawi, Syer, Khdrawi) and the other cultivars group (Barhi, Braim, Dairi, Maktoum, Tibrizil, Hillawi, Kibkab).

Iraq production of Zahdi in 1980 was 46000 tons, which constitutes 66% out of the total production (601000 tons), while in 2009, Zahdi production was 325000 tons, constituting 50% out of the total production (601000 tons). The following table shows date palm production in Iraq during the period 1980 - 2009.

From the above table we can conclude that date production in Iraq is not stable due to different reasons:
- Negligence of date palm orchards due to increased the costs of the cultural operations, and production inputs.
- Aging of the date palm trees and orchards.
- Economic changes, urbanization, and the negative effects of war.
- Devaluation of dates price and production which was:
  - 65kg/tree in 2002
  - 54 kg/tree in 2004
  - 63 kg/tree in 2009

The next table shows date production in Iraqi governorates (ton):

<table>
<thead>
<tr>
<th>Governorate</th>
<th>1990</th>
<th>2000</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diala</td>
<td>76350</td>
<td>116200</td>
<td>51620</td>
</tr>
<tr>
<td>Anbar</td>
<td>36670</td>
<td>49280</td>
<td>38850</td>
</tr>
<tr>
<td>Baghdad</td>
<td>25800</td>
<td>115600</td>
<td>53100</td>
</tr>
<tr>
<td>Babylon</td>
<td>149340</td>
<td>220630</td>
<td>65880</td>
</tr>
<tr>
<td>Karbala</td>
<td>103570</td>
<td>141370</td>
<td>53730</td>
</tr>
<tr>
<td>Wasit</td>
<td>18350</td>
<td>33590</td>
<td>32180</td>
</tr>
<tr>
<td>Salah aldin</td>
<td>22190</td>
<td>17170</td>
<td>4800</td>
</tr>
<tr>
<td>Najaf</td>
<td>24890</td>
<td>25390</td>
<td>24290</td>
</tr>
<tr>
<td>Qadissia</td>
<td>36810</td>
<td>43410</td>
<td>15540</td>
</tr>
<tr>
<td>Myrtha</td>
<td>9210</td>
<td>10720</td>
<td>13230</td>
</tr>
<tr>
<td>Thiqr</td>
<td>21240</td>
<td>52890</td>
<td>20100</td>
</tr>
<tr>
<td>Missan</td>
<td>4030</td>
<td>7950</td>
<td>5420</td>
</tr>
<tr>
<td>Bassrah</td>
<td>16470</td>
<td>97320</td>
<td>48350</td>
</tr>
<tr>
<td>total</td>
<td>544920</td>
<td>931520</td>
<td>432090</td>
</tr>
</tbody>
</table>

During the period from 1980 up till now, date palm faced many negative factors such as wars, negligence...
in cultural practices, salinity, pest’s infection, so that date palm number decreased to (16) millions and the production reached 550000 tons in 1998. As it is shown in the following table.

In addition to another industry like concentrate date juice (Dibis), which is house and commercial industries, there was five big dates industries

<table>
<thead>
<tr>
<th>Governorate</th>
<th>No. of total trees</th>
<th>No. of Fruiting trees</th>
<th>Tree production (kg)</th>
<th>Total production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salah aldin</td>
<td>643400</td>
<td>152700</td>
<td>42.1</td>
<td>22195</td>
</tr>
<tr>
<td>Diala</td>
<td>2159400</td>
<td>16820</td>
<td>45.4</td>
<td>76355</td>
</tr>
<tr>
<td>Baghdad</td>
<td>651600</td>
<td>45300</td>
<td>57.0</td>
<td>25800</td>
</tr>
<tr>
<td>Anbar</td>
<td>798400</td>
<td>63700</td>
<td>57.6</td>
<td>36665</td>
</tr>
<tr>
<td>Babyi</td>
<td>3706500</td>
<td>313900</td>
<td>47.6</td>
<td>149340</td>
</tr>
<tr>
<td>Karbala</td>
<td>2118300</td>
<td>188900</td>
<td>54.8</td>
<td>103576</td>
</tr>
<tr>
<td>Najif</td>
<td>636700</td>
<td>58100</td>
<td>42.8</td>
<td>24890</td>
</tr>
<tr>
<td>Qadissiah</td>
<td>834800</td>
<td>78200</td>
<td>47.1</td>
<td>36810</td>
</tr>
<tr>
<td>Muthana</td>
<td>228700</td>
<td>16500</td>
<td>55.7</td>
<td>9210</td>
</tr>
<tr>
<td>Thiqar</td>
<td>867500</td>
<td>74700</td>
<td>28.4</td>
<td>21240</td>
</tr>
<tr>
<td>Wasit</td>
<td>666200</td>
<td>47000</td>
<td>39.0</td>
<td>18350</td>
</tr>
<tr>
<td>Missian</td>
<td>201100</td>
<td>15200</td>
<td>26.6</td>
<td>4030</td>
</tr>
<tr>
<td>Basrah</td>
<td>2740700</td>
<td>130700</td>
<td>12.6</td>
<td>16470</td>
</tr>
<tr>
<td>Total</td>
<td>16253300</td>
<td>12354700</td>
<td>43.5</td>
<td>544931</td>
</tr>
</tbody>
</table>

The most important local cultivar, which is spread in different countries by tissue culture propagation is Barhee, other local cultivars (Braim, Maktoom, Ashrsi, Kibkab, Diari, Khistawi, other cultivars called trace or rare like (Tabarzil, Haswai, Mirhaj, Sukri, Ashqar, Kintar). The following tabel shows the most important cultivars in Iraqi governorates:

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zahdi</td>
<td>43</td>
</tr>
<tr>
<td>Sayer</td>
<td>23</td>
</tr>
<tr>
<td>Hillawi</td>
<td>13</td>
</tr>
<tr>
<td>Khadrawi</td>
<td>6</td>
</tr>
<tr>
<td>Other cultivars</td>
<td>15</td>
</tr>
</tbody>
</table>

Dates industry in Iraq:
There were many industries in Iraq which is considered one of the pilot countries in this field and the interest is focused on four major industrial projects that depend on Zahdi cv. fruits which represent 60% from Iraq and more than 100 small industries.

**Date palm cultivars:**
Iraq has more than 650 cultivars but the most important cultivars which are commercial and their fruits are exported abroad and represent 85% from date palm trees in Iraq:

<table>
<thead>
<tr>
<th>Project</th>
<th>Quantity of dates (ton)</th>
<th>Quantity of main production (ton)</th>
<th>Byproducts (ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid sugar</td>
<td>41000</td>
<td>30000</td>
<td>10000 forage</td>
</tr>
<tr>
<td>Alcohol production</td>
<td>8000</td>
<td>24000 pure ethanol</td>
<td>0.300 artificial alcohol+2 forage</td>
</tr>
<tr>
<td>Vinegar production</td>
<td>2000</td>
<td>5 million liter</td>
<td></td>
</tr>
<tr>
<td>Yeast</td>
<td>21000</td>
<td>5400</td>
<td>5600 forage</td>
</tr>
</tbody>
</table>
Male Date palm cultivars:

Many date palm male cultivars are available in Iraq:

1- Ghanami which have two clones Ahmer and Akhdar which have high pollen grain activity.

2- Khuki cultivar which have four clones (Khukri, Kraitli, Khukri wardi, Khukri Adi, and Khukri Smasmi).

3- Ghulami.

4- Russasi.

These cultivars in most used in pollination in Iraq but this doesn’t mean there is no other male clones used in pollination. The season of male spathe production started from mid of February till April the cultivars Ghanami and Khukri Adi are early in flowering started in the third week of February while Ghanami Akhdar and Ahmer and Khukri Wardi started in the end of March and beginning of April which is Khuri Kraitli and Smasmi (Mawlood, 2006). The following table shows the characteristics of these cultivar:

from the table we can conclude:

1- The cultivars Ghanami Akhdar, Ahmer, Khukriwardi have the highest rate of spathe production compared to the others.

2- All male cultivars have high viability which was over 90%.

### Date palm general Institution:

In 2000, the Ministry of Agriculture started the National Program of Date Palm Propagation and Improvement, and in 2005 this program changed to the general institution of date palm to develop and improve the date palm sector starting by establishment and develop (30) date palm stations in (13) governorates (260 stations allocated as Gene Bank contains all date palm cultivars in Iraq, specially the famous cultivars in the governorate. The aim of these gene banks was to save all Iraqi cultivars, improve and propagate, conducting researches, using good cultural practices, mechanical operations and producing offshoots.

### Future vision:

Rehabilitation of the degraded date palm orchards, which were destructed harsh conditions that Iraq faced, via establishment of pioneer projects, especially in Al-Basra province form Al-Qurnaa along to Al-Fao and on Shatt al-Arab sides.

Establishment of offshoot field gene banks for date palm in all provinces of Iraq to preserve the varieties and to take advantages of the offshoots for rehabilitation of the deteriorated orchards.

Introduction of the trustee-imported offshoots, which are produced by tissue culture to be disseminated all over the governorates of Iraq.

Continuous campaigns for controlling of different kinds of pests.

Establishment labs for multiplication of date pal using tissue culture techniques.

Amendment of the date fruit-dependent industries and other parts of palm tree, which were prevalent and effective in the past times.
Activation of the extension role and awareness in the field of cultural practices for date palm trees.

Encouraging the private sector to invest in the date palm production sector, especially in packing, storing and export fields.

Encourage using of agricultural mechanization in date palm tree management, specially Iraq was a pioneer in this aspect.

Establishment of cooperatives/associations, mainly in the field of date palm production and dates and date marketing.

**Constraints facing palm trees cultivation:**
Recent researches refer that dates production levels went back to 404 thousand tons in 2005, meanwhile it was 932 thousand tons in 2000, and the revenue of Iraqi dates was just six million dollars comparing to Tunisians and Algerians which reached 47 and 42 million dollars respectively.

Dates and palm fields have been facing several repeated problems for more than 20 years, the most important problems are:

- Carelessness and lack of taking care in palm tree management and the proper implementation of the suitable cultural practices, especially soil preparation, weed control, fertilization, regular irrigation and the suitable treatment of the date palm tree’s head.

- Lack of well-trained workers in the field of palm management, and high production costs.

- Inefficient control of the different pests (insects and diseases), which are the main cause for trees death, poor growth and low productivity.

- The price policy and decrease of financial returns from date palm trees which are not compatible with the efforts exerted in date palm management.

- Water scarcity salinity levels in both water and soil, especially in southern areas.

- Wars effects and destruction of plenty of palm orchards.

Cutting of palm trees to construct new buildings.

Improper of storage, packing and marketing processes.

**References:**


Al-Bekr, A.J. (1972). The date palm. Review of it is past, recent status, and the advances in it is culture , industry and trade.


Photograph from: Liwa Date Festival 2011
Abstract

Atul Ltd. has made long strides in translating its date palm dream - to transform India from the status of a major importer of dates to a major exporter of dates - through a mission mode project. It aims at the massive greening of the deserts of the Western border of India, using date palms, through systematic and scientific approaches, in a phased manner. A well knit strategy is adopted for the effective implementation of the project, on a participatory, public private partnership mode. There are five phases for the implementation of the project. The first part envisages the establishment of model demonstration plantations in key locations. A plantation consisting of seven superior varieties, has been established in an area of 100 hectares at Jaisalmer, Rajasthan. Farm development work on another 40 hectare site at Bikaner, Rajasthan is under progress. The second phase aims to mobilize quality planting materials of superior varieties, consisting of tissue culture plants, for the establishment of plantations. More than 47,000 primary hardened tissue culture date palm plants of four varieties have been imported from Arab nations and subjected to secondary hardening in the newly established nursery at Jodhpur, Rajasthan. The third phase is targeted at capacity building for the generation of tissue culture date palm plants in India, adopting the best protocol available. A joint venture company, Atul Rajasthan Date Palms Ltd. (ARDP), between Atul Ltd and Government of Rajasthan, has been established to set up a Tissue Culture Laboratory at Jodhpur.

The objectives of the fourth phase include large scale scientific
cultivation of date palms in the arid regions of Western India. The fifth phase envisages marketing of fruit and setting up processing industry.

Keywords: date palm, Phoenix dactylifera, tissue culture, cultivation, India, Atul

Introduction
Atul Ltd., a member of Lalbhai Group of companies, is one of the oldest business houses of India. Its registered office is in Ahmedabad, India and its corporate headquarters are located in Atul, Gujarat. It also has offices in the USA, the UK, Germany, China and Vietnam.

Date palm (Phoenix dactylifera) is believed to have been introduced to India by some Turkish sailors. Efforts to develop indigenous production of dates in India were initiated during the 1950s by the Indian Council of Agricultural Research. Some commercial varieties of date palm were introduced from the Middle East, Pakistan and USA. Performance of some of these varieties was encouraging. Arid regions of north-west India, especially Kutch in Gujarat, Rajasthan and south-west Punjab have been identified as potential areas for date palm cultivation in India, besides selected regions in Tamil Nadu, in south India. Currently about 10,000 hectares of land is cultivated with date palm in India, more than ninety per cent being in Gujarat. However, most of the plantations consist of just collection of cultivars / varieties raised from seeds or off shoots belonging to unknown varieties.

Considering the enormous potential of date palm in India, which is the leading importer of dates, Atul decided to support its scientific cultivation in the vast areas of arid lands merging with the Great Indian Desert, spanning over three major states viz., Rajasthan, Gujarat and Punjab. Within a short span of time, Atul has made long strides in translating its date palm dream through mission mode projects, transforming waste lands into greenery with a highly productive and widely acclaimed crop. It will have major impacts on the economic, social and cultural lives of the poor and marginal farmers of India.

Materials and methods
The date palm project of Atul in India is ambitious. It aims at the massive greening of the deserts of the Western border of India, using date palms, adopting systematic and scientific approaches, in a phased manner.

The striking feature of the project is its bearing on technology and scientific inputs. Date palm cultivation, largely, has not been scientific in majority of the areas where it is grown. Superior planting materials and scientific cultivation can boost up the productivity and quality of this crop. This fact is adopted as the base line in the projects of Atul. Benefits of the project will be alleviation of poverty and hunger, enhancement of rural employments, food security, women empowerment and eco-restoration.

A well knit strategy is adopted for the effective implementation of the project, designed on a participatory, public-private partnership mode. There will be five phases for the implementation of the project.

Phase I – Import of secondary hardened plants and setting up demonstration farms

The first part envisages to establish model demonstration plantations in key locations to convince the farmers about the superior performance of date palms, propagated using tissue culture technique.

Phase II – Setting up nurseries, importing primary hardened plants and hardening them further, in India

The second phase aims to mobilize quality planting materials of superior varieties, consisting of tissue culture plants, for the immediate establishment of plantations. Since,
date palm tissue culture plants are not available in India, Atul has adopted an ‘all inclusive approach’ with all the major tissue culture date palm suppliers in the Middle East and tied up with the Date Palm Research & Development Unit of the UAE University, Al-Ain, Al Rajhi Tissue Culture Laboratories, Saudi Arabia and UAE, Al-Wathba Marionnet LLC, Al-Ain and Green Coast Nurseries, Fujairah, for sourcing of planting material.

Phase III – Setting up state-of-the-art tissue culture laboratory-cum-production unit with overseas technology

Phase three targets at capacity building for the generation of tissue culture date palm plants in India, adopting the best protocol available. Tissue culture propagation is an effective and efficient alternative for conventional vegetative propagation, to ensure rapid multiplication and establishment of true to type plants of choice varieties (Mohan Jain, 2007).

Phase IV – Acquisition of land and mass propagation of tissue culture date palm plants

Objectives of phase four include mass propagation and scientific cultivation of date palm in the arid regions of Western India.

Phase V – Marketing of date fruit produce and setting up processing industry

This phase encompasses setting up co-operative societies which in turn will do buy back arrangements for purchase and marketing of date fruit with farmers.

Results and discussion

The arid regions (mainly in Rajasthan, Gujarat and Punjab) cover nearly 12 per cent land area of India. Of this, about 60 per cent (13 million hectares arable lands and 6 million hectares wastelands) can be developed into clusters of date palms, with proper interventions and technical inputs.

Rajasthan, having the largest arid zone land, occupies almost 60 per cent of the arid regions in India. This region has sandy soil of 8 to 10 pH, low rainfall and high temperature. This is further characterized with salinity, brackish underground water, strong wind erosion and low soil fertility which make the cultivation of crops difficult. However, date palm can withstand such extreme stress conditions. Rajasthan has the massive Indira Gandhi Canal Irrigation Programme which caters to more than two million hectares. This makes Rajasthan and adjoining regions of Punjab and Gujarat ideal for cultivation of date palm in India.

Atul and the Government of Rajasthan have outlined a plan for tissue culture date palm cultivation in 2000 hectares in five years. Also, there is a long term plan of cultivating 1,00,000 hectares in further 10 years. This is expected to generate a requirement of more than 15 million tissue culture date palm plants in India in the next 10-15 years.

More than 47,000 primary hardened tissue culture date palm plants of Barhee, Khalas, Khunezi and Medjool varieties (along with male plants) have been imported from Arab nations and subjected to secondary hardening in the newly established nursery at Jodhpur, Rajasthan. The nursery area is 10 ha and consists of more than 5000 m² of hardening facilities. The nursery is equipped with modern drip irrigation and fogging systems. The plants belonging to the varieties Barhee, Medjool, Khalas, Khunzi and Madsari male maintained for one year in the nursery recorded excellent growth (plant height: 54.5 - 75.0 cm; collar girth: 7.8 – 11.6 cm; number of leaves: 6.2 – 8.8; number of pinnate leaves: 1.3 – 2.6; length of the longest leaf: 33.1 – 49.3 cm; width of the largest leaf: 4.2 – 5.3 cm).

A plantation consisting of seven superior varieties, has been established in an area of 100 ha at Jaisalmer, Rajasthan, using tissue culture derived date palm plants of
Barhee, Khadrawy, Khalas, Khunezi, Medjool, Saggai and Zamli. This includes the required number of male plants of Madsari male and Ghannami male also, for effecting pollination. Also, a specific demonstration farm has been established here. Modern techniques of farm development, irrigation and fertilization have been adopted. The irrigation is based on ground water source. Excellent growth was observed for the plants of the above varieties grown in the main field. Plants of the Barhee variety recorded collar girth: 17.3 cm, number of leaves: 8.2, number of pinnae per leaf: 22.0 and length of the longest leaf: 63.8 cm, one year after field planting.

The importing of primary hardened plants and their further hardening before distribution to farmers, with Government subsidy will continue for further three or four years till the phase three of this project is implemented to generate indigenously produced tissue culture planting material.

A joint venture company, Atul Rajasthan Date Palms Ltd (ARDP), between Atul Ltd. and the Government of Rajasthan, has been established to set up a state-of-the-art Tissue Culture Date Palm Laboratory at Jodhpur with overseas technology. This is a typical example of public-private partnership programme where private sector brings in technology, cooperation and efficient management, while the Government support the infrastructure and networking of farmers. Construction of the Tissue Culture Laboratory is in progress.

A Memorandum of Understanding was signed between the UAE University, Al Ain and Atul in presence of H.H. Sheikh Nahyan Mubarak Al Nahyan, Minister for Scientific Research and Higher Education, UAE to transfer technology of tissue culture of date palm to Atul.

Atul is planning to acquire vast areas of arid lands in Rajasthan and set up plantations of tissue culture date palm plants. Also, the Governments of the Western States of India have decided to expand the area under date palm cultivation. In this context, Atul has taken a major role to serve as a leader for date palm development in North West India. This will help create employment in rural arid regions, empower women and reduce the impact of green house gases. The joint efforts of Atul and the Government of Rajasthan shall help farmers to get date palm plants at a subsidized cost and encourage large scale cultivation of this crop. Atul shall provide training modules and other support services to the farmers for adopting the best scientific practices for date palm cultivation. Atul has developed a team of extension personnel, farm managers, scientists, academicians and marketing personnel for this purpose. Technical bulletins for promoting scientific date palm cultivation are being distributed to the farmers. Classes and field training are being organized at the demonstration farms.

Setting up of co-operative societies, which in turn will make buy back arrangements and marketing of date fruit, is aimed at the final phase. Infrastructure for collection of date fruit, grading, processing, packing, storage, logistics, branding, distribution and marketing would be established.

Atul is fully committed to make its dream of turning the dry deserts of India into high calorie green landscapes. It endeavors to involve all stakeholders in its journey to make this dream a reality.

Conclusions

India is the largest importer of date fruit. Atul has made substantial contributions to the date palm development programme in India. Atul is working in unison with all the key stakeholders to implement this unique project, in public-private partnership mode, wherein the strength of public sector and private sector are effectively converged for the project. The project is being implemented in five phases to have continuity and sustainability. It will help generate wealth in desert areas, empower rural population, particularly women and generate rural employment.

Acknowledgements

Thanks to the UAE University, Al-Ain and the Rajasthan Horticulture Development Society for supporting the date palm mission of Atul in India.

Literature Cited

Cultivation of Phoenix dactylifera L. (Date Palm) for Combating Desertification and Enhanced Livelihood: Nacgrab R and D Focus.

Abstract

Nigeria is a country, with diverse landscapes and climatic conditions that result in a corresponding high diversity of biological niches harbouring many plant species. The country is equally endowed with several ecological zones, having on its far south mangrove/swamp while the far north is defined by its almost desert-like climate. Most of the states in this axis are Jigawa, Bornu, Kebbi, Yobe, Sokoto, Katsina and Zamfara. The vegetation cover of these areas is mostly Sudan savannah and Sahel savannah and the desert encroachment in these front line states is so fast and growing at an alarming rate. The resultant effect of this has been mass displacement of inhabitants, farms and their animals thus inflicting hardship and poverty. Meanwhile, studies has shown that few tree crops do relatively well in these areas and one of them identified is Phoenix dactylifera (Date palm). Date palm has high nutritive and commercial value and as well play an important role in the ecology of various desert and semi-desert environments. Date palm, which is an irreplaceable tree in irrigable desert lands, provides protection to under-crops from the harshness of the climate (heat, wind and even cold weather), reduces damage caused by sand storms and wind erosion. It is therefore noted with keen research interest that despite the huge potentials of the Date fruit the availability of planting materials has been the major challenges of the
cultivation and production of this very important desert crop due to the heterozygous and dioecious nature of the plant. The National Centre for Genetic Resources and Biotechnology (NACGRAB) – the national focal point on genetic resources conservation and utilization – in one of her recent germplasm exploration and collection exercises in the affected front line states, is collecting several accessions of Dates which could be subjected to in-vitro propagation techniques using shoot tips and embryos in a modified Murashige and Skoog medium containing adenine, naphthalene acetic acid (NAA) and activated charcoal. The generated plantlets could be sub-cultured into a liquid multiplication media using the Temporary Immersion Bioreactor systems (TIBs). The resultant products are expected to have higher multiplication quotient than when the conventional solid multiplication media is used, thereby increasing the availability of planting materials for Date palm estate establishment in Northern Nigeria.

Keywords: Phoenix dactylifera L, Germplasm, In-vitro, TIBs.

Introduction

Nigeria is situated in the West African coast with a land mass of 923,768 Sq.Km which is characterised with diverse landscapes and climatic conditions that result in a corresponding high diversity of biological niches harbouring many plant species. Out of this, 600 meters of the arable landmass is lost yearly to fast desert encroachment (www.thisdayonline.com, 26th Jan., 2009), especially, in the northern region which is characterised by the Sudan and Sahel savannah vegetation types, thus displacing the inhabitants, farms and their animals and thereby inflicting hardship and poverty, and eventual threat to the Country’s food base. Recent studies has shown that few tree crops do relatively well in these areas and one of them identified is Phoenix dactylifera (Date palm).

Date palm, Phoenix dactylifera L. (Family: Palmaceae), is a monocotyledonous, dioecious palm, and is considered the most important fruit tree in many Arab countries, such as Saudi Arabia and Iraq (Badawy et al., 2005). The Date palm is a very beautiful, elegant and tall palm. It slowly grows about 1 foot a year to a height of 80-100 feet and can live for more than 200 years. Only a female tree can produce dates. Usually it starts producing fruits after 5-8 years. The date fruit consists of 70 % carbohydrates (mostly sugars), making it one of the most nourishing natural foods available to man (FAO, 2002). The flesh of dates contains 60 to 65 % sugar, about 2.5 % fibre, 2 % protein and less than 2 % each of fat, minerals, and pectin substances. Date fruits are also a good source of iron, potassium and calcium, with a very low sodium and fat content thus making it good for anaemia treatment. In addition, moderate quantities of chlorine, phosphorous, copper, magnesium, silicon and sulphur are also found in the date fruit (FAO, 2002). Seeds may be ground for animal feed and the oil is used in soap and cosmetics. The Date
palm tree leaves are used for basketry and wickerwork. The leaves may be used for making huts while the leaves fibres may be made into nets. The trunk may be used for timber works as well as fuel. The trimmed fruit stalks are used as brooms. They are also used for making ropes and belts. The high tannin content of the fruit can also provide medicinal benefits to man, like laxative food and treatment of constipation.

The selenium in date fruit helps enhance the immune system and also lower the risk of cancer and heart diseases. The Date palm syrup and infusion is a good remedy for cough, fever, flu and bronchial catarrh. The roots of the Date palm are used to fight toothaches. Dates are a very good food source for babies. It is an effective medicine for diarrhoea and dysentery during teething time.

All the above enumerated minerals and benefits are the basic ingredients needed for the physical, mental and social development of man. In terms of commerce both national and international trade on Dates are very impressive, FAOSTAT 2002, reported that the world average export trade stands at US$258million as at year 2000 with countries in the middle east dominating the world market. In addition to the dates’ high nutritive and commercial value it is also one of the main trees used for ornamental and landscape (Badawy et. al., 2005). The date palm could play an important role in the ecology of various desert and semi-desert environments. Date palm, which is an irreplaceable tree in irrigable desert lands, provides protection to under-crops from the harshness of the climate (heat, wind and even cold weather), reduces damage caused by sand storms and wind erosion.

Tissue culture is a technique mainly used for rapid propagation of several perennial fruit trees, including date palm (Dass, H.C et al., 1989). However, adequate availability of planting materials has been the major challenges of the cultivation and production of this very important desert crop in Nigeria. Plant in vitro regeneration is a biotechnological tool that offers a potential solution to this problem as it provides a means of putting the plants onto the market at lower prices.(Afolayan and Adebola, 2004). Problems of planting materials and propagation of date palm arise from the fact that the tree has a long life cycle (Ammar and Badeis, 1983), and that the number of off-shoots produced by them is limited to a certain period in the life of the tree (Barret, 1973). Also, the tree is dioecious and heterozygous. Abo EL-Nil(1986) and AL-Ghamdi (1993) The success of date palm cloning by tissue culture methods, based on organogenesis and somatic embryogenesis, has been investigated by many workers. Organogenesis in date palms has a low efficiency due to the low number of explants that form plantlets in-vitro, the long time required for the initiation phase, the low multiplication rate and the strong influence of the variety (Poulain et al., 1979; Beauchesne, 1982). Somatic embryogenesis has been obtained from shoot tips which were excised from off shoots, Tisserat (1979 and 1982), Sharma et al. (1984, 1986 and 1991), Zaid and Tisserat (1983), Mattar (1986a), Daguin and Letouze (1988),
Diwaker et al. (1998), Djamila and Bougedoura (1988), with the resulting embryo regenerating into plantlets Bekheet et al, 2000; Badawy et al. (2005).

To meet the increasing demand for date palms, it is necessary to complement the tissue culture techniques with Temporary Immersion Bioreactor system (TIBs) to enhance the commercial production of date palms seedlings.

Mass propagation of plants by tissue culture is laboured intensive and costly; this therefore calls for a need to advance on the technique. TIBs is the use of liquid medium for in vitro culture and it is a relatively recent micro propagation procedure that allows connotation increase of multiplication and automation quotient. It is an automated micro propagation process through the use of bio reactors which have been designed to provide maximum opportunities for monitoring and controlling environmental condition, immersion time, i.e. duration or frequency, which is the most critical parameter for system efficiency.

TIBs is comprised of two glass flasks of variable capacity, one for the growth of the explants and another as deposit of the culture media. These flasks are connected by silicone tubes by means of the connectors (either ‘T’, ‘L’ or straight/parallel). In the second connector of each flask similar tube is placed with a hydrophobic filter of 0.22 micron in the other end of these tubes, to guarantee the sterility of the air. In the internal part of each cover two tubes are also placed to one of the connectors, one that has as function to extract the culture media in both recipients. The means of circulation from a flask to another dependence on the opening or closing of the electro valves (solenoids), which are connected to a programmable timer to regulate the frequency and the duration of the immersion. The pressure of air is regulated by a gauge coupled to the air compressor, and also controlling its automatic ignition.

The plants are exposed to the liquid medium intermittently rather than continuously and as the plants are not always in contact with the medium, nutrients absorption and growth rate are thus stimulated, therefore it has greater feasibility of producing higher plantlets volume.

Temporary Immersion systems for plant micro-propagation can be described and grouped into 4...
Cultivation of Phoenix dactylifera L. (Date Palm) for Combating Desertification and Enhanced Livelihood

Categories according to operation:

i) Establishment of the plant on a solid medium, machines,

ii) Partial immersion of plant material and renewal of nutrient medium, by gradual reduction of the agar concentration,

iii) Partial immersion on a liquid nutrient renewal mechanism,

iv) Complete immersion by pneumatic driven transfer of liquid medium and without nutrient medium renewal. It has also frequently been considered an ideal technique for mass production as it reduces production costs, followed by a reduction in shelving area requirement and the number of containers used; manual labour and facilitates changing the medium composition. Complete atmosphere renovation inside the recipient at regular intervals, which means there is no large accumulation of gases like ethylene. Agitation due to air flow during the immersion phase, causes scattering of vegetative tissues.

Plant material propagated by temporary immersion performs better during the acclimatization phase than material obtained on semi-solid or liquid media. Hyperhydricity, which seriously affects cultures in liquid medium, is eliminated with these culture systems or controlled by adjusting the immersion times, quite little immersion time, in which most of the tissues are covered with a film of media.

Figs. i- v TiBs shelve, showing the principal components, Timers, Bottles, and solenoids valves.

Thus, the aim of this study is to investigate how to complement the tissue culture techniques with the TiBs for commercial production of date palms seedlings for possible establishment of its estates in the front line states through participatory approach with the farmers and the communities.

Materials and methods

This study will be conducted at the Tissue Culture Lab of the National Centre for Genetic Resources and Biotechnology (NACGRAB) Ibadan, Nigeria. It will involve the collection of offshoot of date palm from across its geographic range.

Plant material

Two years old offshoots of Phoenix dactylifera will be carefully separated from their mother plants (female date palm) when they will be 60-80 cm tall, with 8-12 leaves and used as a source of explants. The shoot tip and axillary bud will be the explants to be used.

Preparation of explants

Sterilization and culturing of explants

In the laboratory, Offshoot leaves will be removed acropetally till the tender portion will be reached. It will be further trimmed to completely remove the woody tissues and keep the succulent shoot – tip intact. The tips obtained will be kept in an antioxidant solution. The date palm shoot
tips (1-2 cm long, with a diameter of approximately 0.5-1.0 cm), including the apical meristem will be excised and cut into 4. The explants (the tips and axillary buds) will be washed with liquid detergent under running tap water, and then it will be surface sterilized by immersing in 70% Ethanol for 5 minutes and in a solution of sodium hypochlorite (20% V/V) containing few drops of Tween 20 for 20 minutes. This will be followed with rinsing thrice in sterile distil water. Then, using a simple microscope under a lamina flow hood, the young leaflets and part of the core's tissue will be removed gradually till reaching the top bud and will be inoculated on a Murashige and Skoog (1962) medium (MS).

Culture media
The initiation media contain MS medium containing 100 mg/l 2, 4-D + 3 mg/l 2ip. The pH of the medium will be adjusted to 5.7 before the addition of agar. The culture medium will be distributed into culture jars (150 ml), each containing 25 ml of the prepared medium. The jars will be covered and autoclaved at 121 °C under a pressure of 0.15 psi for 20 minutes. The shoot tips and axillary buds (explants) will be inoculated for a period of 18 weeks to obtained callus formation, as reported by (Badawy et. al., 2005). The callus obtained will be transferred into a medium without hormones and activated charcoal to enhance embryo production and development. Tisserat (1979), using sucrose concentration of 30 g/l, and incubating the explants on the culture medium for 24 weeks for the formation of somatic embryo and subsequently plantlets regeneration from the embryogenic callus (Bekheet et. al., 2000). These developed shoot and buds will then be transferred into TIBs in a liquid medium under a control condition for further multiplication. The shoots will be regenerated and rooted on a cultured medium containing 40 g sucrose/l, 9 g/l charcoal (AC) and 1.5 mg/l of NAA for a period of 18 weeks. The rooting of date palm was favourably influenced by the presence of activated with increase in the number of roots and root length.

Acclimatization and Establishment.
The rooted plantlets will be acclimatized under the greenhouse condition. The plantlets will be rinsed in water in water to remove the adhering agar. These will be planted in prepared moist soil medium consisting of sterile peat and vermiculite mixture in small perforated polythene bags. These will be transfer to the humidity chamber for hardening. The hardened plants will be transfer to the nursery for some weeks before establishment on the field.

Expected results and Conclusion
Availability of planting materials usually faced by the farmers in the adjoining communities in the front line states.

The farmers will also be trained in the seedlings handling, plantation establishment, sustainable fruits harvesting and marketing thereby addressing both the desertification menace and poverty alleviation

References


Djamila, C. and Bougedoura, N. (1988). Plant regeneration via organogenesis and somatic embryogenesis in two cultivars Takerbouchet and Deglet Nour) of date palm (Phoenix dactylifera L.) from Algeria. The First International Conference on Date palm, Fac. of Agric. Sci., Al-Ain, United Arab Emirates, March 8-10, (Conference Abstracts).

FAO (2002.) Date palm cultivation: FAO plant production and protection paper, 156 (1).

FAO (2002.) FAOSTAT statistical data base.


Tisserat, B. (1982). Factors involved in the production of plantlets from date palm callus.

Exploring the Nigerian Date palm [Phoenix dactylifera. L] Germplasm for in vitro Callogenesis

Abstract

Date palm is believed to have been introduced into Nigeria in the early 8th century by Arab traders from north Africa. Date fruits are highly valued delicacy among many communities in Nigeria, especially during ceremonies and festivals. The national consumption of dates in 2009 is estimated at 8,958 metric tons which placed the country among the world top 10 consumers of date. Despite conducive soil and climatic conditions for date palm cultivation and the existence of local varieties with good fruits qualities, date palm cultivation is still at subsistance level and demostic production is estimated at only 1,958 metric tons. Attempts to improve the Nigerian date palm industry through the establishment of commercial date palm plantations has been hindered by lack of good planting materials. However, recent evaluation of the response of some of the Nigerian date palm cultivars to 2,4-D induced callogenesis demonstrated the high propensity of the genotypes to in vitro culture, with more than 50% embryogenic callus formation on modified MS supplemented with 50µm 2,4-D in all the genotypes tested. Further research is needed to complete and optimise this protocol in order to solve the problem of date palm planting materials in the country.

Keywords: Phoenix dactylifera, Genotypes, 2,4-Dichlorophenoxy acetic acid (2,4-D), Callus Formation, Callus maintenance, morphotype.
Introduction

Date palm (Phoenix dactylifera) is believed to have been introduced into Nigeria in the early 8th century by Arab traders from north Africa, where it is traded in exchange with the dry leaves of Henna plant (Lawsonia inermis), a plant widely used for body decoration by women in many parts of the world. Date fruits are highly valued delicacy among many communities in Nigeria and enjoys a great spiritual and cultural significance. Nigerian date consumption as at 2009 is estimated at 8,958 t out of which 78% (7,000 t) were imported from Niger republic and North Africa via the trans-Sahara trade route. This value is significant when compared with 10,000 t imported annually by the United Kingdom which is among the 4 leading importers of date (FAO, 2003). However, only 22% (1,958 t) of the date consume is produce locally and this value is far below the annual production of Mexico (3,600 t) which is the least among 18 leading producers of dates (FAO, 2003).

In Nigeria, datepalm thrives well in the semi arid region (120 to140° N and 20 to140° E). This area forms an undulating plain with general elevation ranging from 450m to 700m and is covered by ferruginous tropical soils characterised by sandy-fixed undulating topography and is characterised by wet (June to October) and dry (November to May) season (Mortimore, 1989). The prevailing soils and climatic conditions in this region support the growth of diverse date palm ecotypes and double fruiting per season with the second fruiting terminating at Kalal stage due to high humidity (June- August). Date palm cultivation is still at subsistance stage, where diverse cultivars are grown in homestead and few ochards by local date growers. Previous attempts to improve date palm cultivation through the establishment of commercial plantations were not successfull due to limited number of planting materials. Tissue culture remains the most efficient alternative for rapid mass propagation of selected date palm genotypes. Protocols for in vitro regeneration of date palm based on somatic embryogenesis or organogenesis were reported (Tisserat, 1979; Zaid and Tisserat, 1983; Showky and Mahmoud, 1998; Al-Khalifa, 2004; Eke et al., 2005; Asemota et al., 2007; Ahmad et al., 2009). However, genotype specificity in their response to in vitro regeneration made it necessary to develop protocol for every date palm genotype (Hesselman, 1997). Since embryogenic culture allow for cyclic recovery of more plants, regeneration via somatic embryogenesis is an attractive alternative for rapid clonal propagation of date palm. In date palm, callogenesis is a prerequisite step to achieving in vitro propagation via somatic embryogenesis. The objective of this study was to assess the calgenic competence

Fig1. Callus induction from (10-15mm) long juvenile leaf segments of date palm (P. dactylifera). A- white compact embryogenic callus excised from leaf segment of DPP1W after cultivation on modified MS supplement with 50µM 2,4-D for 60 days. B-White and brown compact callus from juvenile leaf segment of DPP3 after cultivation on modified MS supplemented with 50µM 2,4-D for 60 days.
in selected date palm genotypes in response to 2,4-D treatment.

**MATERIALS AND METHODS**

**Callus induction**

Two to three-year-old offshoots of female plants of 7 date palm genotypes (Table 1) were obtained from germplasm bank of National Institute for Oil palm Research, Date palm substation Dutse, Jigawa State (11.70N, 9.30 E) in August 2008. After removing the mature leaves, offshoots were trimmed down to the apical bud region. Soft tissue segments measuring about 20-40 mm were cleansed with soap solution and treated with 20% w/v Benlate (Benomyl methyl-(butylcartamoyl)-2-benzimidazole carbamate) solution for 60 minutes. The segments were surface sterilized by dippen in 70% ethanol for 1 minute followed by immersion in 20% commercial bleach (3% Sodium hypochlorite) for 15 minutes and rinsed 3 times in sterile distilled water. The surface sterilized segments were further cut into small pieces (10-15 mm) and inoculated on modified MS supplemented with 2,4-D (50, 100, 150, 200 µM 2,4-D). For each treatment, callus with an average fresh weight of 500 mg was equally divided into 5 masses and incubated in baby food jar containing 35 ml of the media. Each treatment had three replications laid in completely randomised design. All the datepalm genotypes tested in this study demonstrated optimum response to callus induction when cultured on induction medium containing 50µM 2,4-D (Table 2). The pH of the medium was adjusted to 5.8 with 1M NaOH and solidified by adding 0.8% agar-agar (BDH, England), before autoclaving at 121ºC and 1.04 Kg cm² for 15 minutes. All cultures were raised in baby food jar (67x55 mm), each dispensed with 35 ml of the medium. Cultures were incubated at 29 ± 1ºC under continuous dark and were examined at an interval of 10 days. After 30 days of incubation, the explants were subcultured on fresh media containing the same concentrations of 2,4-D and incubated for another 30 days. After 60 days of culture the number of segments forming callus were recorded and expressed as percentage callus induction.

**Callus maintenance**

White compact callus was selected and subcultured on MS media supplemented with 50, 100, 150, 200 µM 2,4-D. For each treatment, callus with an average fresh weight of 500 mg was equally divided into 5 masses and incubated in baby food jar containing 35 ml of the media. Each treatment had three replications laid in completely randomised design. All treatments were cultured in dark for 30 days. Increase in the fresh weight of the callus was recorded and the proliferation coefficient was calculated. Data obtained were subjected to analysis of variance (ANOVA) (SAS, 1998) and means were separated using Duncans multiple range test.

**RESULTS**

**Callus induction**

Preliminary experiment showed that fungal contamination in leaf segments obtained from offshoots was as high as 90% and can be reduce to < 10% by treating the explant with 20% benlate for 60 minutes. Explant cultured in the dark on 2,4-D free medium did not produce callus. Majority of the explant turned brown and showed intense oxidation and die after 4 weeks of culture. Explant culture on the induction media containing 2,4-D and incubated for another 30 days. After 60 days of culture the number of segments forming callus were recorded and expressed as percentage callus induction.

### Table 1: Fruit phenology and 2007 average yield/plant of the date palm genotypes used for the in vitro studies in 2008

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Fruit type</th>
<th>Fruit colour</th>
<th>seed</th>
<th>Yield /plant (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDP1W</td>
<td>Semi dry</td>
<td>Dark brown</td>
<td>Small</td>
<td>79.8</td>
</tr>
<tr>
<td>DDP2W</td>
<td>Semi dry</td>
<td>Light brown</td>
<td>Medium</td>
<td>106.3</td>
</tr>
<tr>
<td>DDP3</td>
<td>dry</td>
<td>Dark red</td>
<td>medium</td>
<td>50.8</td>
</tr>
<tr>
<td>DDP4</td>
<td>Soft</td>
<td>Light brown</td>
<td>small</td>
<td>86.1</td>
</tr>
<tr>
<td>DDP5</td>
<td>Semi dry</td>
<td>Light brown</td>
<td>small</td>
<td>63.2</td>
</tr>
<tr>
<td>DDP8</td>
<td>Soft</td>
<td>Dark brown</td>
<td>small</td>
<td>68.3</td>
</tr>
<tr>
<td>DDP9</td>
<td>dry</td>
<td>Dark brown</td>
<td>small</td>
<td>94.0</td>
</tr>
</tbody>
</table>

**Callus maintenance**

White compact callus was selected and subcultured on MS media supplemented with 2,4-D (50, 100, 150, 200 µM 2,4-D). For each treatment, callus with an average fresh weight of 500 mg was equally divided into 5 masses and incubated in baby food jar containing 35 ml of the media. Each treatment had three replications laid in completely randomised design. All treatments were cultured in dark for 30 days. Increase in the fresh weight of the callus was recorded and the proliferation coefficient was calculated. Data obtained were subjected to analysis of variance (ANOVA) (SAS, 1998) and means were separated using Duncans multiple range test.
any increase in response to in vitro callogenesis. There were significant differences among the genotypes in their response to callogenesis (Fig. 2). DPP1W (74.88%) and DPP8 (74.22%) produce the highest percentage callus induction and were different (P < 0.0001) from DPP9 (69.91%).

Differences among the four 2,4-D concentrations tested in this study were also significant (Fig. 4). Among the 2,4-D concentrations tested, 200 µM (85.25%) produce the highest percentage callus induction and the number of responding leaf segments significantly decreases with reduction in the concentration of 2,4-D.

### Callus proliferation

In order to assess the effect of 2,4-D on the proliferation of embryogenic callus in datepalm, white compact callus masses of average weight 100mg were subculture on media enriched with 2,4-D at the same concentrations used for callus induction for 30 days. On the basis of increase in callus fresh weight the treatments were grouped into two; the first group (50 µM -100 µM 2,4-D) increase the callus fresh weight by 1.0 to 2.5 fold and the second group (150 µM-200 µM) resulted in the increase in the callus weight by 3.0 to 4.5 (Table 2). Significant differences were also observed among the genotypes in their response to in vitro callus proliferation (Fig 3) providing an insight that callus proliferation was in one way or the other influenced by the date palm genotype.

### DISCUSSION

Mass propagation and genetic improvement of date palm requires the development of reliable in vitro regeneration system. Since callogenesis is a prerequisite step to achieving in vitro propagation via somatic embryogenesis, development of protocol for efficient callogenesis is a critical stage in achieving rapid propagation of genotypes of interest.

<table>
<thead>
<tr>
<th>Genotype</th>
<th>50 µM (2,4-D)</th>
<th>100 µM (2,4-D)</th>
<th>150 µM (2,4-D)</th>
<th>200µM (2,4-D)</th>
<th>Mt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% CI means±sd</td>
<td>%CI means±sd</td>
<td>%CI means±sd</td>
<td>%CI means±sd</td>
<td></td>
</tr>
<tr>
<td>DPP1W</td>
<td>50±7.29</td>
<td>77±8.77</td>
<td>79±10.87</td>
<td>92±6.07</td>
<td>wc</td>
</tr>
<tr>
<td>DPP2W</td>
<td>62±9.64</td>
<td>69±9.47</td>
<td>78±11.52</td>
<td>85±9.47</td>
<td>wc</td>
</tr>
<tr>
<td>DPP3</td>
<td>54±10.50</td>
<td>75±12.66</td>
<td>69±12.18</td>
<td>84±7.81</td>
<td>wc</td>
</tr>
<tr>
<td>DPP4</td>
<td>57±9.64</td>
<td>66±11.12</td>
<td>85±11.05</td>
<td>85±9.40</td>
<td>wc</td>
</tr>
<tr>
<td>DPP5</td>
<td>59±12.12</td>
<td>66±6.01</td>
<td>79±7.11</td>
<td>79±7.24</td>
<td>wc,b</td>
</tr>
<tr>
<td>DPP8</td>
<td>59±11.20</td>
<td>75±9.79</td>
<td>72±7.95</td>
<td>91±5.93</td>
<td>wc</td>
</tr>
<tr>
<td>DPP9</td>
<td>55±9.22</td>
<td>69±4.81</td>
<td>76±4.97</td>
<td>98±4.82</td>
<td>wc</td>
</tr>
<tr>
<td>Genotype</td>
<td>PC means±sd</td>
<td>PC means±sd</td>
<td>PC means±sd</td>
<td>PC means±sd</td>
<td>-</td>
</tr>
<tr>
<td>DPP1W</td>
<td>2.67±0.30</td>
<td>3.06±0.35</td>
<td>3.09±0.48</td>
<td>4.36±0.48</td>
<td>wc</td>
</tr>
<tr>
<td>DPP2W</td>
<td>2.14±0.42</td>
<td>2.78±0.50</td>
<td>3.07±0.15</td>
<td>3.13±0.94</td>
<td>wc</td>
</tr>
<tr>
<td>DPP3</td>
<td>2.50±0.28</td>
<td>2.49±0.16</td>
<td>2.95±0.60</td>
<td>3.27±0.46</td>
<td>wc</td>
</tr>
<tr>
<td>DPP4</td>
<td>2.45±0.18</td>
<td>2.80±0.18</td>
<td>4.09±0.42</td>
<td>4.0±0.38</td>
<td>wc</td>
</tr>
<tr>
<td>DPP5</td>
<td>2.35±0.06</td>
<td>3.07±0.24</td>
<td>3.45±0.34</td>
<td>3.96±0.56</td>
<td>wc</td>
</tr>
<tr>
<td>DPP8</td>
<td>2.38±0.09</td>
<td>2.45±0.15</td>
<td>3.53±0.33</td>
<td>5.16±0.56</td>
<td>wc</td>
</tr>
<tr>
<td>DPP9</td>
<td>2.34±0.12</td>
<td>3.62±0.38</td>
<td>3.94±0.49</td>
<td>4.45±0.38</td>
<td>wc</td>
</tr>
</tbody>
</table>

Key: CI-callus induction, PC- Proliferation coefficient, sd- standard deviation, Mt-callus morphotype

Proliferation Coefficient = \[
\frac{Fresh \ Weight \ (30 \ days \ after \ subculture)}{Fresh \ Weight \ (before \ subculture)}
\]
In this study, the seven date palm genotypes effectively produced embryogenic callus from immature leaf segments in media containing 2,4-D. In the case of date palm, leaf segments were reported to be the most competent tissue to form callus (Gueye et al., 2009). Callogenesis in date palm leaf segments in the presence of 2,4-D is characterized by two key events; The activation of fascicular paranchyma (FP) and reinitiation of cell cycle by callogenic perivalcular sheath cells (PSCs) leading to dedifferentiation and callus formation (Gueye et al., 2009). Due to its stability 2,4-D has been used in the induction of callogenesis in wide range of species (Gaj, 2004; Ali et al., 2008). All the 2,4-D concentrations used in this study produced callogenesis > 50%, demonstrating the efficacy of 2,4-D in the induction of callogenesis in date palm. This finding coincide with the report of Sane et al. (2006) and Othmani et al. (2009) on callogenesis in leaf segment of P. dectylifera. Auxin mediated callus induction has been linked to certain factors which may trigger the complete chain of events that influence the ability of cultured cells to grow in an organized fashion. The presence of specific receptor, that reside either on cell membrane or within the cytoplasm (Mockeviciute and Anisimoviene, 1999). Specific binding site for both auxin has been identified (Kim et al., 2001). A class of proteins called expansins mediates the proton ability to cause cell wall loosening by breaking the hydrogen bonds between the polysaccharide components of the wall (Cosgrove, 2001). Proton (H+) pumping and lowering of cytosolic pH result in an elevation of intracellular calcium level (Shishova et al., 1999). Both cytosolic pH and calcium ions have been associated with early auxin action (Zhang, 2003). Calcium ions, either themselves and or along with calcium binding proteins e.g., calmodulin activate the protein kinase cascade which in turn activates other proteins, including the transcription factors (Wagner, 2001). These factors presumably interact with the auxin-response elements and regulate the expression of auxin-inducible or auxin-responsive genes and exert its effect on cell cycle and stimulate cell division (Johri and Mitra, 2001).

The current study has shown that callogenesis in date palm increase with corresponding increase in the concentration of 2,4-D from 50-200µM. This phenomenon was also reported to be more vigorous in date palm leaf segments cultured on media enriched with 50-200µM 2,4-D (Othmani et al., 2009) and 54–270 µM NAA (Gueye et al., 2009).

Callogenesis was to great extent influenced by the date palm genotypes. For example, callus induction and proliferation were >74% and > 3.3 fold respectively in DPP1W and DPP8, these values were significantly higher (P<0.001) than results obtained in the other five genotypes tested in this study. The type of callus tissue developed was also found to be genotype dependent. While white and compact callus was common to DPP1W, DPP2W, DPP4, DPP8 and DPP9, a mixture of white

![Fig. 2. Effect of genotype on the in vitro callogenesis in date palm](image1)

![Fig. 3. Effect of genotype on callus proliferation 30 days after subculture](image2)
and brown compact callus was common feature in DPP3 and DPP5. Similar observations were reported in African cassava by Atehkceng et al., 2006. Variation in the response of the date palm genotypes to in vitro callogenesis could probably due to their physiological differences, particularly the endogenous IAA levels. Endogenous IAA levels were demonstrated to be the main difference between leaf segments with various grades of callogenic competence in date palm (Gueye et al., 2009).

In this study all the date palm genotypes demonstrated a high success for callogenesis in leaf segments obtained from 2-3 year old offshoots. These genotypes exhibited optimum callogenesis when culture on modified MS supplented with 50 µM 2,4-D and their response increases with an increase in the concentration of 2,4-D, demonstrating their high propensity to in vitro callogenesis. Further research is needed to complete and optimise this protocol in order to solve the problem of date palm planting materials in the country.

**Acknowledgement**
The authors thanks Jigawa Research Institute, kazaure, Jigawa State, Nigeria for financing the research project.

**References**


Exploring the Nigerian Date palm [Phoenix dactylifera L] Germplasm for in vitro Callogenesis


Carry N. C.


Inefficiency in Market Profit Distribution Effected Date Palm Production in Yemen

Abstract
Farmers in Yemen are facing many problems related to natural resource endowments, availability of water and in the marketing of their products. Despite the difficult natural circumstances the farmers produce agricultural commodities, including Date palm.

This product is sometimes sold in local markets and sometimes the product is sold to middlemen who transport the commodities to the markets or directly to the consumers. The value added in the chain will be distributes over the various actors, the farmers, the transportation sector and the middlemen.

As a result of the actions of the middlemen only a small part of the value added in the chain is to the benefit of the farmers. The prices that
are offered to the farmers do not allow compensating for the costs and this result in low profits or no profits at all to the farmers.

As a result, the farmers are not able to expand their activities and are facing very low incomes and the risk of complete bankruptcy. This is a limiting factor for agricultural development and hampers modernization of the Date palm trees in Yemen.

Based on the feasibility study of Net Revenue (\$/ha) for farm in Wadi Hadramout during 2002 to 2006 the net revenue is negative for the farmers. In 2006 farmers lost is 233-\$/ha. While the middlemen gain profit of about 4,256 (\$/ha, for the same Year that means the net marketing margin is 244% for the middlemen profit. Marketing is frustration for small farmers in Yemen. Farmer’s production increased, but their income did not.

Keywords: Inefficiency in Market Profit Distribution Effected Date Palm Production in Yemen. Farm Gat Price, producer surplus, Consumer price, Market marginal, Middleman marketing profit, Fair prices. [Very poor keywords selections.]

Methodology

This study was based on data collected from the Ministry of Agricultural and Irrigation Yemen, Department of Monitoring and Evaluation, for the cost of Date Palm producers, market intermediaries in production. The Retail price of Date Palm was calculated from Sana’a City market. Wadi Hadramout was selected for this study because it is considered the main Date Palm growing area in Yemen.

The successful use of advanced methods of marketing analysis is heavily dependent on the availability of data which is not the case in Yemen, secondary data like national statistics and surveys conducted by different organizations. Especially with the latter, it is likely that they have followed different standards and procedures and hence may vary significantly in quality, validity and representativeness. Hence, there is a need for a thorough validation and repeated discussion of the results. Such discussion will yield the need for additional data collection, especially when dealing with specific operational decisions such as intervention targeting and support intensity. In order to empirically advance for this case the existing data had used in the input –output analysis (See Table 1-5 in appendix 1) for Date Palm marketing analysis in Wadi Hadramout.

Market margin analysis

Marketing margin are the differences between prices at two market levels farm get price and consumers price. Marketing margins have been examined on the basis of data obtained on prices at different stages of the marketing chain. Marketing margins have been calculated through computing the absolute margins or price spread, which is essentially the same as the difference between the prices, paid and received by each specific marketing agency. The following formula has been used to compute percentage marketing margins as earned by each market intermediary in the marketing of farm products.

1- Farm profit = Gross Revenue (\$/ha) - Total costs (\$/ha) (See Table 2).
2- Marketing Margin = Farm get price – Consumer price. (See Table 3).
3- Percentage marketing margins= Farm get price – Consumer price/ Farm get price * 100 (See Table 4).

Table 2 shows that Farm profit = Gross Revenue (\$/ha) - Total costs (\$/ha = 1,744 - 1,977= -233(\$/ha. That means farm has received less prices than the real cost of production.

The average period lost is -806 (\$/ha (2002 to 2006).

Table 3 shows that middlemen have received high profit it is 1,109 (\$/ha in 2002 up to 4,256 (\$/ha in 2006, with average period 2,307 (\$/ha.

Table 4 shows percentage Marketing margins earned by the middlemen in Sana’a is 172% 2002 to 244% in 2006 with average period 238%

Breakdown of consumer’s one USA Dollars

Breakdown of consumer’s dollars is a phrase applied to the manner in which a consumer’s one dollars expenditure on a particular commodity is divided among the producer and marketing agencies. It shows from Table 4 that portion of a consumer’s dollars which goes to the producer is 0.44 cent and 1.06 is earned by various marketing agencies such as contractors, commission agents, wholesalers and retailers. This was calculated by expressing the net margin of a specific agency as proportion of the retail price.

Marketing costs

The marketing margin indicates the amount received by different marketing agencies for providing their services, from the time when commodity leaves the farm until it reaches the consumers. Such costs are not known and it is not included in the analysis.

Conclusions

Like farmers throughout the world, but especially in developing countries, Yemeni farmers work hard throughout the year to produce high quality crop and livestock products in sufficient quantities to reach profitable levels.
Table 1. Crop budgets of the means cropping patron in Wadi Hadramout 2006.

<table>
<thead>
<tr>
<th>Cropping pattern</th>
<th>Average</th>
<th>Dates</th>
<th>Alfafa</th>
<th>Mango</th>
<th>Banana</th>
<th>Onion</th>
<th>Tomato</th>
<th>Garlic</th>
<th>Potato</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Revenue($) /ha</td>
<td>4,469</td>
<td>1,744</td>
<td>6,380</td>
<td>7,356</td>
<td>4,905</td>
<td>3,834</td>
<td>-</td>
<td>7,200</td>
<td>4,336</td>
</tr>
<tr>
<td>Total costs ($)/ha</td>
<td>1534.7</td>
<td>1,977</td>
<td>2,265</td>
<td>2,372</td>
<td>2,221</td>
<td>1,150</td>
<td>359</td>
<td>1,060</td>
<td>873</td>
</tr>
<tr>
<td>Net Revenue ($)/ha</td>
<td>2,935</td>
<td>233</td>
<td>4,115</td>
<td>4,984</td>
<td>2,684</td>
<td>2,684</td>
<td>359</td>
<td>6,140</td>
<td>3,463</td>
</tr>
</tbody>
</table>

Calculated from Tables in appendix 1.

Table 1 shows that all crops net revenue is positive, except the Date Palm and Tomato are negative by 233 and 359 US$. 

Table 2. Net Revenue ($)/ha for farm Date Palm in Wadi Hadramout 2002 to 2006.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield(kg)/ha</td>
<td>4,000</td>
<td>2,200</td>
<td>2,080</td>
<td>1,384</td>
<td>1,350</td>
</tr>
<tr>
<td>Farm gate price ($/kg)</td>
<td>0.44</td>
<td>0.4427</td>
<td>0.421053</td>
<td>0.34</td>
<td>0.479</td>
</tr>
<tr>
<td>Gross Revenue ($)/ha</td>
<td>1,744</td>
<td>974</td>
<td>876</td>
<td>473</td>
<td>646</td>
</tr>
<tr>
<td>Total costs ($)/ha</td>
<td>1,977</td>
<td>1,959</td>
<td>1,583</td>
<td>1,706</td>
<td>1,521</td>
</tr>
<tr>
<td>Net Revenue ($)/ha for farm</td>
<td>233</td>
<td>985</td>
<td>707</td>
<td>1,232</td>
<td>875</td>
</tr>
</tbody>
</table>

Calculated from Tables in appendix 1.

Table 3. Net Revenue ($)/ha for middlemen in Sana’a City 2002 to 2006.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer Price (retail price in Sana’a City)</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.3</td>
<td>1.30</td>
</tr>
<tr>
<td>Gross Revenue($)/ha</td>
<td>6,000</td>
<td>3,300</td>
<td>3,120</td>
<td>2,075</td>
<td>1,755</td>
</tr>
<tr>
<td>Total costs ($)/ha</td>
<td>1,744</td>
<td>974</td>
<td>876</td>
<td>473</td>
<td>646</td>
</tr>
<tr>
<td>Net Revenue ($)/ha for middlemen</td>
<td>4,256</td>
<td>2,326</td>
<td>2,244</td>
<td>1,602</td>
<td>1,109</td>
</tr>
</tbody>
</table>

Calculated from Tables in appendix 1.

Table 4. Percentage Marketing margins earned by the middlemen in Sana’a 2002 to 2006.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm gate price ($/kg)</td>
<td>0.44</td>
<td>0.4427</td>
<td>0.42105</td>
<td>0.34</td>
<td>0.479</td>
</tr>
<tr>
<td>Consumer Price ($/kg)</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.3</td>
<td>1.30</td>
</tr>
<tr>
<td>Market Margin ($/kg)</td>
<td>1.06</td>
<td>1.06</td>
<td>1.08</td>
<td>0.96</td>
<td>0.82</td>
</tr>
<tr>
<td>% Market Margin ($/kg) for middlemen</td>
<td>244.12</td>
<td>238.82</td>
<td>256.25</td>
<td>280.00</td>
<td>171.56</td>
</tr>
</tbody>
</table>

Middlemen profit = Gross Revenue ($)/ha - Total costs ($)/ha = 6,000 - 1,744 = 4,256 ($)/ha. From the table (4) the marketing margins earned by the middlemen in Sana’a was (1.06/.44*100) = 244($/kg) (Retail price in Sana’a City).
Table 5. Date palm prices in Sana’a City 2007-2008.

<table>
<thead>
<tr>
<th></th>
<th>2008 price ($/kg)</th>
<th>Inflation Rate</th>
<th>2008 price (YR/kg)</th>
<th>2007 price (YR/kg)</th>
<th>Kind</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>200</td>
<td>600</td>
<td>300</td>
<td>300</td>
<td>Al-Ngrani (Saudi)</td>
</tr>
<tr>
<td>2.5</td>
<td>167</td>
<td>500</td>
<td>300</td>
<td>300</td>
<td>Al-Hadhramy(Saudi)</td>
</tr>
<tr>
<td>2.75</td>
<td>183</td>
<td>550</td>
<td>300</td>
<td>300</td>
<td>Al-Bashy(Saudi)</td>
</tr>
</tbody>
</table>

www.alghadyem.net

However, also like farmers everywhere, Yemeni farmers lack marketing information, alternatives, knowledge, skills, tools, and institutions to make the most of selling the products they worked so hard to produce. Marketing issues are particularly frustrating for farmers because they often perceive that the ‘middle man’ or the broker gets more of the consumer dollar than the farmer does. Marketing is frustration for small farmers in Yemen. Farmer’s production increased, but their income did not.

**Recommendations**

It is strongly recommended that policy for equity and normally margin profit for both Farmers and middlemen are applying inside the retail market areas in Yemen.

Efforts to Improve Date Palm Production in Yemen and link it with food security and poverty elevation.

Agricultural economists at the Faculty of Agriculture, Sana’a University, Sana’a, ROY, in cooperation with UAE University Conduct joint baseline survey to carry out reliable econometric analysis in Date Palm Production in Yemen.

Farmers want new marketing principles to enhanced marketing capacity and policy for small farmers to get fair prices for their productions.

**References**


Daniel H. Pick, Jeffrey Karrenbrock, Hoy F. Carman, Price asymmetry and marketing margin behavior: An example for California - Arizona citrus [Year, Publication Date?]

Food and Agriculture Organization of the United Nations (FAO); United Nations World Food Programme (WFP), Special, Report - FAO/WFP Crop and Food Security Assessment Mission to Yemen, Date: 09 Dec 2009.


Ministry of Agriculture and Irrigation, (MoAI), The Cost of production of mean crops in Hadramout, Department of Monitoring & Evaluation, Sana’a Yemen, 2007.

Table 5 explains the market situation, Retail price in Sana’a City increased from 1.5 US$ in 2007 to 3 US$ in 2008 this means the inflation rate is 200% for date palm. Also, Family Budget Survey 2008 indicted that Yemen had import date palm from Saudi Arabia by 30 million USA dollar, these indicted demand is higher than supply.

**Appendix 1.**

Crop budgets input output Analysis of the means cropping patron in Wadi Hadramout 2002 to 2006.
<table>
<thead>
<tr>
<th>Cropping pattern</th>
<th>Dates</th>
<th>Alfafa</th>
<th>Banana</th>
<th>Onion</th>
<th>Tomato</th>
<th>Garlic</th>
<th>Potato</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area cultivated(million ha)</td>
<td>1</td>
<td>0.005</td>
<td>0.00321</td>
<td>0.00022</td>
<td>0.00123</td>
<td>0.00025</td>
<td>0.00012</td>
</tr>
<tr>
<td>Rainfed area (million ha)</td>
<td></td>
<td>0.002695</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigated area (million ha)</td>
<td></td>
<td>0.00270</td>
<td>0.00321</td>
<td>0.00022</td>
<td>0.00123</td>
<td>0.00025</td>
<td>0.00012</td>
</tr>
<tr>
<td>Irrigation water use(m3/ ha)</td>
<td>2</td>
<td>19,987</td>
<td>21,640</td>
<td>25,583</td>
<td>12,459</td>
<td>7,032</td>
<td>11,509</td>
</tr>
<tr>
<td>Total irrigation use(MCM)</td>
<td></td>
<td>53.86</td>
<td>69.51</td>
<td>5.63</td>
<td>15.32</td>
<td>1.78</td>
<td>1.36</td>
</tr>
<tr>
<td>Yield(kg)/ha</td>
<td></td>
<td>4,000</td>
<td>11,000</td>
<td>11,964</td>
<td>8,520</td>
<td></td>
<td>4,500</td>
</tr>
<tr>
<td>farm gate price($/kg)</td>
<td></td>
<td>0.44</td>
<td>0.580</td>
<td>0.41</td>
<td>0.5</td>
<td></td>
<td>1.6</td>
</tr>
<tr>
<td>Gross Revenue($)</td>
<td></td>
<td>1,744</td>
<td>6,380</td>
<td>4,905</td>
<td>3,834</td>
<td></td>
<td>7,200</td>
</tr>
<tr>
<td>Water related costs ($/ m3)</td>
<td></td>
<td>0.08</td>
<td>0.08</td>
<td>0.06</td>
<td>0.06</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Capital costs($/m3)</td>
<td></td>
<td>0.043</td>
<td>0.039</td>
<td>0.031</td>
<td>0.028</td>
<td>0.025</td>
<td>0.023</td>
</tr>
<tr>
<td>Maintenance($/m3)</td>
<td></td>
<td>0.0072</td>
<td>0.007</td>
<td>0.005</td>
<td>0.005</td>
<td>0.004</td>
<td>0.004</td>
</tr>
<tr>
<td>Operation-Diesel ($/ m3)</td>
<td></td>
<td>0.033</td>
<td>0.030</td>
<td>0.024</td>
<td>0.022</td>
<td>0.019</td>
<td>0.017</td>
</tr>
<tr>
<td>diesel use (litre/ m3 water)</td>
<td></td>
<td>0.18</td>
<td>0.165</td>
<td>0.134</td>
<td>0.120</td>
<td>0.108</td>
<td>0.097</td>
</tr>
<tr>
<td>Cost of diesel($/litre)</td>
<td></td>
<td>0.179</td>
<td>0.162</td>
<td>0.131</td>
<td>0.118</td>
<td>0.106</td>
<td>0.095</td>
</tr>
<tr>
<td>Operation (Oil $/m3)</td>
<td></td>
<td>0.003</td>
<td>0.003</td>
<td>0.002</td>
<td>0.002</td>
<td>0.002</td>
<td>0.002</td>
</tr>
<tr>
<td>Labor costs ($/ha)</td>
<td></td>
<td>124</td>
<td>382</td>
<td>397</td>
<td>317</td>
<td></td>
<td>316</td>
</tr>
<tr>
<td>Other cost 4</td>
<td></td>
<td>175</td>
<td>197.00</td>
<td>210</td>
<td>125</td>
<td>215</td>
<td>219</td>
</tr>
<tr>
<td>Irrigation water applied(m/ha)</td>
<td></td>
<td>2.00</td>
<td>2.16</td>
<td>2.56</td>
<td>1.25</td>
<td>0.70</td>
<td>1.15</td>
</tr>
<tr>
<td>water cost ($/ha)</td>
<td></td>
<td>1,678</td>
<td>1,686</td>
<td>1,614</td>
<td>708</td>
<td>359</td>
<td>529</td>
</tr>
<tr>
<td>Total costs ($/ha)</td>
<td></td>
<td>1,977</td>
<td>2,265</td>
<td>2,221</td>
<td>1,150</td>
<td>359</td>
<td>1,060</td>
</tr>
<tr>
<td>Net Revenue ($)</td>
<td></td>
<td>233</td>
<td>4,115</td>
<td>2,684</td>
<td>2,684</td>
<td>359</td>
<td>6,140</td>
</tr>
<tr>
<td>Returns to water $/m3</td>
<td></td>
<td>0.1</td>
<td>0.3</td>
<td>0.2</td>
<td>0.3</td>
<td>-</td>
<td>0.6</td>
</tr>
</tbody>
</table>

1. Ag. S. Sources of Area and productivity are the Agricultural Year Kook – 2002 to 2006.
3. DRC .
4. Other cost (manure, urea, chemical fertilizers, chemicals) ($/ha)