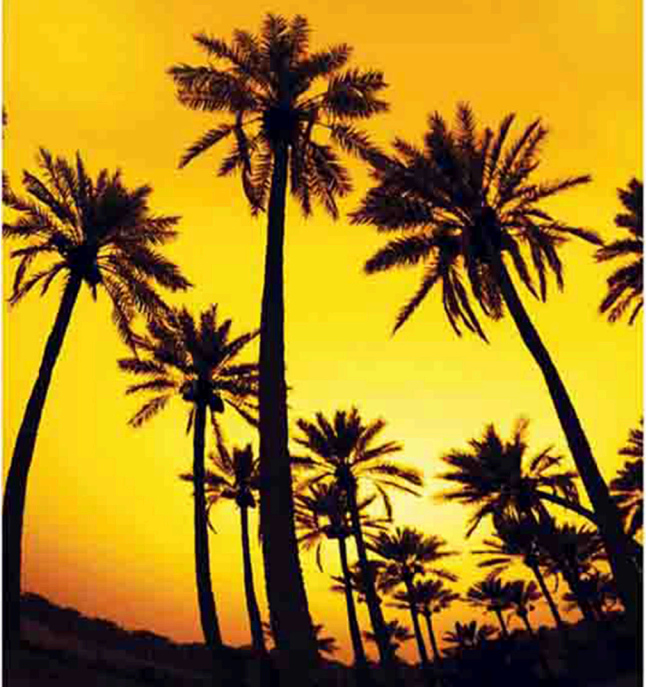
The Blessed Tree

Volume No. 2, Issue No. 04, December 2010 KHALIFA INTERNATIONAL DATE PALM AWARD

جائزة خليفة الدولية لنخيل التمر
KHALIFA INTERNATIONAL DATE PALM AWARD

UAE wins award for best international pavilion in the field of date palm



SAEED MOHAMMED AL RAQBANI

THERE IS NO LEADER IN THE WORLD WHO SHOWED INTEREST TO THE BLESSED TREE, SUCH AS THE LATE SHEIKH ZAYED

MAP OF PREVAILING DATES VARIETIES IN THE UAE HAS CHANGED FROM UNDESIRABLE VARIETIES TO VARIETIES WITH HIGH ECONOMIC VALUE

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رئيس الدولة «حفظه الله»

وإلى صاحب السمو الشيخ

محمد بن راشد آل مكتوم

نائب رئيس الدولة رئيس مجلس الوزراء حاكم دبي «رعاه الله»

وإلى إخوانهما أصحاب السمو الشيوخ
أعضاء المجلس الأعلى للإتحاد - حكام الإمارات «حفظهم الله»

وإلى الفريق أول سمو الشيخ

محمد بن زايد آل نهيان

ولي عهد أبوظبي - نائب القائد الأعلى للقوات المسلحة

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جائزة خليفة الدولية لنخيل التمر
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جـائـزة خـلـيـفـة الـدولـيـة لـنـخـيـل الـتـمـر
KHALIFA INTERNATIONAL DATE PALM AWARD

Our Tree

UAE Nationals are proud of the Union Identity

We celebrate the Anniversary of the establishment of United Arab Emirates in 1971 every year on the 2nd of December which is a true historical turning point in the life of UAE citizens. It moved them from the fragments status to the union status in its full sense of the word. It took them to a true horizon in the new era, with all its implications from technological advancement that affect all life features. Should we really want to celebrate this achievement which is substantially exceeded expectations, so we ought to protect our gains and continuously develop them and do our best not to be part of the past or just history. We should strive to keep these achievements continued, grow and maximize them every day so as to add to the citizens more and more welfare.

No doubt that the union made us strong in every aspect and introduced us through the past thirty nine years to broader horizons in building and construction, growing and development, socially, economically, educationally and in health sector.

Therefore, keeping this union have to be on the top of our priorities and interests where we should keep as same as it was the days of the founding father of this nation the late Sheikh Zayed Bin Sultan Al Nahyan (God Rest His Soul In Peace) and make use of all our potentials and capabilities to support this union and strengthen it under the wise leadership of His Highness Sheikh Khalifa Bin Zayed Al Nahyan, UAE President.

To pursue confident steps in our development towards a more promising future, this starts with upholding our union and strengthening its elements and features to be the driving force to attain more achievements.

Nowadays we celebrate the 39th Anniversary of the union of the people of UAE, while we miss its founder, but still his grand achievements witness his eternity in our hearts and minds. We shall remember him in every occasion, we still remember his great deeds and generous hands and light moments in our hearts and the minds of people and their lives and his great role to establish our country and its robust economy. UAE citizens shall keep and protect the union and honor the promise and the commitment and make great efforts and do their best to place UAE in the highest position and keep it proud and in glory to be always on top of the nations.

Nahyan Mabarak Al Nahyan
Minister of Higher Education and Scientific Research
Chairman of Khalifa International Date Palm Award Board of Trustees

جائزة خليفة الدولية لنخيل التمر
KHALIFA INTERNATIONAL DATE PALM AWARD

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**

جائزة خليفة الدولية لنخيل التمر
KHALIFA INTERNATIONAL DATE PALM AWARD

Our Messege

Qualitative Move

Khalifa International Date Palm Award gained many prizes and awards during the last three years at local, regional and international levels, this proves day after day the credibility of its strategy and the clarity of its vision and its established profound objectives to achieve. Thanks to the directives of His Highness Sheikh Khalifa Bin Zayed Al Nahyan, UAE President and the support of H.H. Sheikh Mohamed Bin Zayed Al Nahyan, Crown Prince of Abu Dhabi and Deputy Supreme Commander of UAE Armed Forces, and the interest of H.H. Sheikh Mansour Bin Zayed Al Nahyan, Deputy Prime Minister and Minister of Presidential Affairs and the keen continuous follow up of H.H. Sheikh Nahayan Mabarak Al Nahayan, Minister of Higher Education & Scientific Research, Chairman of the Board of Trustees of Khalifa International Date Palm Award.

Here we can safely emphasize three main points, the first point that UAE won the first place as the best booth at the participating countries in the First International Date Forum in the Kingdom of Morocco, hosted by the city of Erfoud in Errachidia District at Oases Region east of the Kingdom of Morocco during the period from September 30 to October 3, 2010. All bodies concerned in the Kingdom of Morocco commended the qualitative participation of UAE in the International Date Exhibition which witnessed more than 100 thousand visitors from the region and specialists across the Kingdom of Morocco, where the UAE delegation enjoyed a proactive role at all various activities and events of the forum leading to be awarded with the merit certificate.

The second point is the excellent results of the qualitative increase of the candidates who applied to the Award categories in its third session 2011, where the number of candidates who applied reached 131 applicants representing 24 countries worldwide, with a remarkable increase compared to the last session amounted 95% in the number of applicants broken down to the five categories of the Award, namely; Distinguished Research / Studies, Distinguished Producers, The Best New Technique, The Best Development Project, and Distinguished Figure .

The third point is the spirit of the teamwork of the General Secretariat of the Award and they feel that they are responsible to maintain this success and move over to more and more achievements to meet the vision of H.H. Sheikh Nahayan Mabarak Al Nahayan, Minister of Higher Education & Scientific Research, Chairman of the Board of Trustees of Khalifa International Date Palm Award who is very interested in supporting and strengthening the leading role of UAE in the field of date palm cultivation and production of dates at the regional and international levels.

Dr. Abdelouahhab Zaid
Secretary General of Khalifa International Date Palm Award
Editor in Chief

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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.

جائزة خليفة الدولية لنخيل التمر
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Nahayan Mabarak reviewed result of the nominations and applauded the efforts

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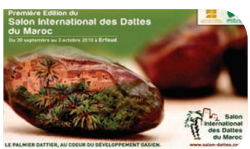

UAE wins award for best international pavilion in the field of date palm

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With the closing date of nomination for Khalifa International Date Palm Award in its Third Session

Nahayan Mabarak reviewed result of the nominations and applauded the efforts made in this regard

An increase of 95% in nominations at the Third Session 2011.

HH Sheikh Nahayan Mabarak Al Nahayan, Minister of Higher Education and Scientific Research, Chairman of the Board of Trustees of Khalifa International Date Palm Award has reviewed yesterday the outcome of nominations of the Award and applauded the efforts and maneuvers put into that which reflect the great confidence achieved by the Award in its Third Session and its distinguished presence at the different scientific and production circles at the national, regional and international levels. That was achieved with the wise leadership of HH Sheikh Khalifa bin Zayed Al Nahyan, UAE President and the support of HH Sheikh Mohamed bin Zayed Al Nahyan, Crown Prince of Abu Dhabi and Deputy Supreme Commander of UAE Armed Forces.

H.E. Dr. Abdelouahhab Zaid, the General Secretary of Khalifa International Date Palm Award pointed out that with the end of the closing of nominations for the Award in its Third Session 2011 the number of applicants reached 131 representing 24 countries from all over the world with a remarkable increase of 95% in the number of nominees distributed to five categories Distinguished Research / Studies, Distinguished Producers, The Best New Technique, The Best Development Project, Distinguished Figure.

H.E. Dr. Zaid expressed his content of the remarkable increase in the number of applicants in the different categories where Distinguished Research / Studies category has recorded the highest participation percentage at the level of countries. The General Secretariat has received various participations from across the world namely; Saudi Arabia, Oman, Egypt, Syria, Morocco, Lebanon, Iraq, Jordan, Somalia, Algeria, Sudan, Palestine, Tunisia, Kuwait, Bahrain, UAE in addition to India, Italy, Poland, Eritrea, Canada, Pakistan, Bangladesh and Bosnia.

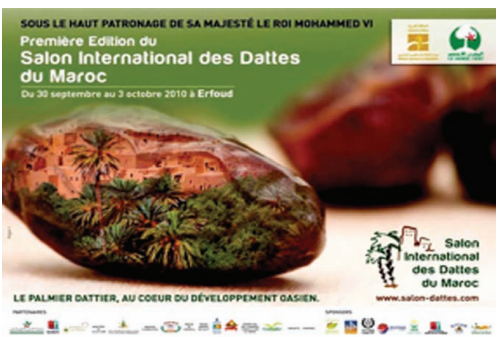
Arab countries have achieved the highest participation percentage among participating countries, where 16 Arab countries participated against 8 countries from across the world which means 67% of Arab countries and 33% from the rest of the world. Dr. Zaid referred that the office of the General Secretariat has started its works by sorting out and evaluating the participating works with a process enjoyed a high transparency and complete impartiality since the inception of the Award.

The Secretary General reiterated the importance of the introductory tour that was recently conducted during last summer in the following countries: Kuwait, KSA, Bahrain, Oman, Qatar, Syria, Jordan, and Morocco, in which all details of the Award were presented. The positive outcomes of this tour contributed significantly in a remarkable increase of participants from these countries.

The SG also stressed at the end of his speech at the objectives of the Award that it aspires to achieve and the most prominent the leadership role of UAE globally to develop and grow the scientific research of date palm and encourage those involved in the sector of date palm cultivation from researchers, growers, producers, exporters, organizations, societies and specialist bodies moreover honoring the distinguished figures in the field of date palm at the national, regional and international levels.

Through its participation in the First International Date Palm Forum in the Kingdom of Morocco

UAE wins award for best international pavilion in the field of date palm



UAE won the first place for the best booth at the level of participating countries in the first session of the International Date Forum in the Kingdom of Morocco 2010, where His Excellency Mr. Aziz Akhannouch, Moroccan Minister of Agriculture and Fisheries granted the Certificate of Merit to the head of UAE delegation during a ceremony honoring winners of the best production and best exhibitors in the Forum hosted by the city of Erfoud in Errachidia District at Oases Region east of the Kingdom of Morocco during the period from September 30 to October 3, 2010.

Dr. Abdelouahhab Zaid Secretary General of Khalifa International Date Palm Award expressed his delighted with the win the first place of the

UAE amid the broad international participation, stressing that the credit for that goes back to the directives of HH Sheikh Nahayan Mabarak Al Nahayan, Minister of Higher Education and Scientific Research, Chairman of the United Arab Emirates University , Chairman of the Board of Trustees Award Khalifa International Date Palm, in the context of strengthening the leading role of the UAE in support of Development Date Palm Sector at the international level, under the wise leadership of His Highness Sheikh Khalifa bin Zayed Al Nahyan, UAE President and the support of His Highness Sheikh Mohammed bin Zayed Al Nahyan, Crown Prince of Abu Dhabi and Deputy Supreme Commander of the UAE Armed Forces.

The Minister of Agriculture and Fisheries Morocco HE Aziz Akhannouch has inaugurated the Dates International Exhibition in 2010 Erfoud south east of the Kingdom of Morocco under the auspices of Moroccan King Mohammed VI, with the participation of the United Arab Emirates and a number of Arab countries including Algeria, Tunisia, Libya, Egypt, Iraq, Jordan, United Arab Emirates, Saudi Arabia, with the aim of exchanging experiences and expertise in this area in order to improve productivity and quality of dates.

The Moroccan Minister of Agriculture accompanied by Minister of Water and a number of senior government officials visited UAE pavilion at the exhibition comprised of the wing of the United Arab Emirates University represented by the Date Palm Research and Development Unit, Award Khalifa International Date Palm booth and booth of Tiba Company for Engineering Industries, where he was received by Dr. Abdelouahhab Zaid, Secretary General of the Khalifa International Award Date Palm and the accompanying delegation which

provided a detailed explanation on the participation of UAE in this important international event.

The Agricultural Moroccan Minister expressed his admiration for the this initiative and praised the keen interest and leadership in the UAE to promote scientific research in the field of date palm, and noted the outstanding participation of the UAE in the International Dates Exhibition. The exhibition which brought more than 100 thousand visitors, including investors and researchers aims at exchange knowledge between different actors in the field of date palm in order to explore the technical and technological progress in the area of date palm cultivation and production dates. Also sought to promote agricultural activity in the oases through the presentation of agricultural products and a partnership between the various parties involved, as well as creating a dynamic economic region from this event.

With Directives of Nahayan Mabarak Al Nahayan, UAE strengthens its international standing in the field of date palm cultivation and production of dates

The show also includes products for different derivatives of the dates as an initiative by a group of Rural women and local associations, as well as semi-products, of date palms. This Exhibition is a space to bring together producers, cooperatives and associations concerned with the valuation and packaging and craftsmen and the assemblies of network production of this wealth, and also among the many Arab participating countries.

The Minister of Agriculture and Fisheries visited various corridors of the exhibition, where he was briefed about the experiences of associations and scientific studies in the field of oases economy, in addition to different varieties of dates being the products of cooperatives concerned in Dates processing and packaging.

The Award Secretary General referred that such participation comes as a realization of the directives of HH Sheikh Nahayan Mabarak Al Nahayan, to expand the work scope of the award in various parts of the world, especially Arab countries to let the largest possible sector of researchers and specialists, farmers and lovers of a palm tree dates know about the award and encourage them to apply for the award categories.

Pursuant to the Introductory Tour by the Award General Secretariat after the launch of its third session last summer, which included GCC countries, Syrian Arab Republic and the Hashemite Kingdom of Jordan in order to brief the professionals and specialists on the five award categories and how to apply for them and how to prepare technical dossiers, in addition to briefing professionals and specialists on the award activities such as the International Photography Competition titled (Date Palm through the eyes of the world).

Results of winners:

It is worthy to mentioned that the jury, which paid visits to the Exhibition's corridors, awarded the prize of the best initiative for the Federal Professional Producers of Dates, while the prize of the best display awarded to the (Jinan Erfoud) Cooperative.

As for the prize of valuation of date palm cultivation equipments, it has been awarded to Dar Al-Falah Company, while Guelmim farming Chamber got the prize for the best activation of the exhibition. And the exhibition's organizers granted within the framework of accompanying measures to improve the dates sector, a group of awards to dozens of dates producers such as M/S. Lahssan Cruwayt from Goulimim,

and Lihsaini Al Hashemi from Zagora, and Muhammad Buyali from Tagjijt (Guelmim), and Marzouk Mohammed from Figuig, Mohamed Belhassen from Erfoud, then Madani Nouman from Zagora.

Also the jury chose in the context of valuation of the sector Award, three Cooperatives and young man contractor. And it related to cooperatives Tasagala Aqa (Tata), and the Al Masira (Figuig), and Aufus (Errachidia), then the young contractor Abdul Rahim Akran from Agdez.

Scientific Conference:

The first scientific days on the date palm has started its activities on 2 and October 3, 2010 in Al Ati Hotel where 26 working paper of scientific journals have been submitted in five scientific sessions with the participation of a select group of researchers and specialists in palm cultivation and production of dates in the world. And

100 thousand visitors visited the International Date Exhibition including investors and researchers

the presence of a large number of interested professionals, researchers in date palm cultivation and the production of dates in Tafilalt area east of the Kingdom of Morocco.

Where Dr. Abdelouahhab Zaid Secretary General of Khalifa International Date Palm Award inaugurated the scientific sessions with a paper work on the economic importance of date production and international trade in which he referred to the global status of date production and international trade of the exporting and importing countries to the European markets, the main consumer of dates in the world and his data was based on the statistics of Food and Agriculture Organization (FAO). He referred to the digital divide between production and exports in the Arab region compared to the output of the rest of the world and its share of the international market.

Dr. Hassan Shabana, member of the UAE delegation, and expert Date Palm Global Network has also presented in his paper work entitled the reality of date palm cultivation and production of dates in the Arab region and the main activities to improve the specification of production in quantity and quality. He pointed out that the Arab States still represent the largest areas of date palm plantations and production dates accounting for more than 75% of the number of date palm trees in the world.

While the date palm economic returns in Arab States is the lowest compared to other producing countries, and the reasons are the lack of use of modern production techniques to improve its quality and quantity and with lower production costs.

In the third paper presented by Dr. Samir Al Shaker, member of UAE delegation and Advisor in Date Palm Global Network, entitled the global development of new technologies in the production and marketing of dates, where he presented the most important modern techniques used in the manufacture and marketing of dates around the world, because this industry has become industries related to food security for many countries, in addition to their economic importance, so we see this focus across the world.

Signing of Agreement:

The Exhibition witnessed the signing of two contracts and an agreement with a total amount of more than AED 800 million, by the Minister of Agriculture and Fisheries, Mr. Aziz Akhannouch and Mr. Tariq Al-Sijilmassi, Chairman of the Board of Directors of Crédit Agricole Group, The agreement provides the support and financing of 35 thousand producers growers beneficiaries of the program of development and rehabilitation date palms.

This project, which has been designated with a financial cover estimated at AED 737 million, includes the Oases region, which has an area of 47 thousand hectares, within the framework of government contribution amounted to AED 35 billion distributed over 10 years. With regard to the two contracts were concluded with (Kaliagro) company and (Ismoghai) Biotechnology Laboratory. It is planned to provide growers of Oasis region about 250 plants (seedlings) of date palm trees, where a financial cover valued AED 64 million has been allocated, with the support of the Agency of Partnership for Progress. And date palm seedlings will be distributed to growers of Oases region at the level of 12 oasis located at districts of Zagora and Errachidia and Tinghir, Tata and Figuig.

Through these recent operations, which fall within the planting of productive and fruit trees project the Agency of Partnership for Progress has allocated approximately $ 219 million, added to $ 300.9 million for the previous project, about 73 per cent of the total budget.

Such activities fall within the framework of the implementation of the Charter of the Millennium Challenge - Morocco Agreement concluded on 31 August in Tatwan under the presidency of His Majesty King Mohammed VI, between the Governments of United States, represented in the "Millennium Challenge Corporation" and the Kingdom of Morocco, which has allocated the amount of 697.5 million dollars. Both contracts have been signed in the presence of Mr. Murad Obaid, the Director-General of the Agency of Partnership for Progress.

زيادة عدد المشاركين في مسابقة تصوير
النخلة في عيون العالم 2011

Saeed Mohammed Al Raqbani

He is a man from the time of Zayed. The time of the agricultural development, which included all agricultural sectors and the most important was Date Palm cultivation and Production of Dates, His Highness Sheikh Zayed bin Sultan Al Nahyan (may God rest his soul) gave this agriculture most of his interest and appreciation for recognizing the importance of blessed tree in the lives of people of the UAE through history, especially the pre-oil era.

A man who witnessed Zayed while serving his tenure in office as Minister of Agriculture in the UAE, for which he was the Minister of Agriculture and Fisheries for 29 years (1977-2006). He spent this period in the development of the agricultural sector, fisheries, livestock and water in the country which proved its existence and well-deserved position at both levels at the regional and international arenas, thanks to the wisdom and the leadership of His Highness Sheikh Zayed bin Sultan Al Nahyan (may God rest his soul) who said, (Give me agriculture, I guarantee you Civilization).

He is a man who witnessed the qualitative move in the cultivation of

There is no leader in the world who showed interest to the blessed tree, such as the Late Sheikh Zayed

palm trees and dates in the UAE to be more than forty million trees by the grace of Allah Almighty and the efforts and guidance of the founding leader the late Sheikh Zayed bin Sultan Al Nahyan (may God rest his soul), he is HE Saeed Bin Mohammed Raqbani.

What does palm tree mean to you?

Palm is that generous and lofty tree that Allah blessed it and made it sustenance of the people. It has been mentioned in the Old Testament, the Bible and mentioned many times in the Quran, as it was stated in many verses. It is a blessing bestowed by Allah Almighty in the UAE a long time ago, man of this region knew it as a source for his living and a great help for his life and he took proper care of it until he gained the experience which made him invest in all of the date palm and what it has, as well as the investing in its fruit and secured his food needs, so the Date Palm occupied today a prominent place in the priorities of food security and has become a national wealth that should be saved, and an integrated food with its production surplus is growing year after year and a renewed giving from a generation after a generation.

The Messenger of Allah (Peace Be Upon Him) urged us to grow palm trees and take care of it and its propagation, He (Peace Be Upon Him) said (Even though it is the Day of Judgment and there is an offshoot in the hands of any one, could he be able to plant it, he should plant it) and He also said (date palm and trees, are a blessing for their people and their descendants).

Pursuant to what was stated in the Holy Quran and the Hadith on this blessed tree and from its importance as a national wealth, it received a special care from the late Sheikh Zayed bin Sultan Al Nahyan (may God rest his soul), who laid down the foundations of this agricultural development, which have continued and sustained confidence and the wise leadership of His Highness Sheikh Khalifa bin Zayed Al Nahyan as a leader, a teacher and father of all the people of this generous country, we are all guided by his directives in the way of success and outstanding achievements and leaps that have been made in the agricultural field in general and the area of date palm cultivation and production of dates in particular.

Since when do you start to be interested in planting palm trees?

I'm the son of the agricultural environment. I has lived with the work in the land since my childhood, I loved farming and was obsessed by it and by the grace of Allah have been honored with confidence and trust of His Highness Sheikh Zayed bin Sultan Al Nahyan (may God rest his soul) to be Minister of Agriculture and Fisheries (formerly) for a period of twenty-nine years, out of the professional liability this concern has embodied on the base of science and knowledge and keep pace with scientific and technological development at various levels. Farming for me is not the office but in the field.

The date palm tree is one of the oldest trees and is a source of dates which provide a high nutritional value more than other fruits, where one kilogram of dates provide 3000 calories, so the blessed tree requires all our attention, care and appreciation.

Map of prevailing dates varieties in the UAE has changed from undesirable varieties to varieties with high economic value

What are the major stops and achievements you have made to the blessed tree?

I have contributed in a positive way and continue to contribute in advancing the development and agricultural development at various levels, especially date palm sector, after UAE has attained unprecedented achievements in this sector, in the fields of agriculture and tree-planting and the spreading of the green areas with the grace of Allah Almighty and the strong determination of the late the founding leader Sheikh Zayed bin Sultan Al Nahyan (may God rest his soul) who conquered the desert and transmitted it to gardens and green fruit farms in an exciting experience gained worldwide attention and appreciation and admiration. The System of work was distinguished (during my tenure in office as Minister of the Ministry of Agriculture) and depended on the central planning and decentralized implementation and worked on the establishment of four agricultural regions at the national level which have agricultural units in order to facilitate the service of the agricultural sector, growers and extension in the cultivation of palm trees, we created many of the agricultural experimental stations, the most important were (stations of Hamaraniah - Dhaid - Dibba), and Hamaraniah research station in Ras Al Khaimah was distinguished in the field of agricultural research on the tree date palm and the fight against pests and diseases that affect the Palm, the most important red palm weevil, where a patent has been registered in this area to combat the weevil by using fungus.

We managed through growers supporting programs by the agricultural experimental stations and extension centers that provide guidance and expertise to growers free of charge to produce high quality palm trees as well as the introduction of new varieties at low prices and our commitment to supply all growers by providing these palm trees and provide them with all the modern agricultural techniques and provide all the necessary means to ensure a sustainable agricultural sector, preserve the environment and contribute to enhancing food security.

Under the guidance and support of His Highness Sheikh Zayed bin Sultan Al Nahyan (may God rest his soul) we were able to market dates of the growers in the emirates of UAE to encourage them to expand cultivation of varieties of better quality dates, and improve the specification of dates that have high marketing prices to growers, and thus increase the economic returns to production dates. Thereby providing an incentive for grower to develop his production and adhere to the genuine Agriculture.

We worked on the development of water sources in the country, at the same time on saving irrigation water to keep the reservoir of groundwater, the expansion in the use of modern irrigation systems where the agricultural areas that implements a method of modern irrigation reached about 80 per cent of the total irrigated area in the country, resulting in saving of manpower of labor and about 60% of irrigation water due to reducing waste, consequently increasing the efficiency of irrigation.

On the other hand, we constructed dams in different regions of the country to reserve large amounts of rainwater. We also worked to

support and develop national human resources through the provision of scientific missions to them within and outside the country and the Ministry of Agriculture and Fisheries has many technical and specialized scientific skills.

How do you assess the reality of date palm cultivation in the UAE?

Various institutions of the state have focused on the palm tree with a great interest which enjoyed the lion share of the plans, promotional and outreach programs guided by the directives of the leadership in this regard, aiming towards growth and development of production in quality and quantity, in order to make it an economic return on the one hand and a stock which is full of promise on the other hand, we introduced this modern and scientific methods concerned with planting and care of the Date Palm and resisting the diseases and pests.

UAE is one of the advanced countries in the date palm cultivation and production of dates, where it has a remarkable growth and development in this area, both in increasing the rate of date palm cultivation and expansion in the area of farms and thus UAE became at the forefront of the world in this area (i.e. in the rapid expansion in the cultivation of palm) and this expansion marked by introducing the varieties with high economic value.

What do you think the agricultural pattern of date palm in the UAE?

Here we must distinguish between two types, the former pattern of old agricultural and latter is modern pattern, and by virtue of time, I have witnessed both patterns and has worked in cooperation with all parties for the introduction and application of modern pattern in date palm cultivation and production of dates at the national level, the United Arab Emirates is one of the most important areas famous of cultivation of date palm and since ancient times, which traditional methods prevailed at the time of in production, characterized by low and declining productivity and irrational use of water resources and the small areas where there were some old farms are still present until now, old farms that were created before the sixties are marked by heavily date palm density, but modern pattern, it covers farms which were established during the decades of the seventies and eighties and nineties and under

the then guidance of Commander of the late His Highness Sheikh Zayed bin Sultan Al Nahyan, these farms were marked by using scientific methods developed in the establishment and sustainability and improved farm management, in addition to a clear development and improvement in plant production in general, and the large agricultural areas, which led to the provision of necessary resources and funding, necessary support and create marketing channels for dates.

This pattern is also characterized by systematic and large distances between the palm trees (7 × 7 m to 8 × 8 m) relatively, as well as other trees and the rational use of water for irrigation through the introduction of modern irrigation systems. Furthermore, UAE is one of the first countries to focus on tissue culture initiated with UAE University to establish date palm tissue culture laboratory in February 1989 which is capable of producing hundreds of thousands of date palm seedlings of high quality.

Thanks to the efforts of His Highness Sheikh Nahayan Mabarak Al Nahayan, Minister of Higher Education and Scientific Research, Chancellor of the United Arab Emirates University, the laboratory gained an international standing as one of the largest contingents to the propagation of date palm trees. Then the Ministry of Agriculture and Fisheries (formerly) in 1997, initiated to introduce the best quality date palm seedlings within support program at nominal prices, which contributed to the dissemination of good varieties.

On the other hand we can safely say that, as a result of great interest in cultivation of date palm trees the annual production of dates has increased from 8000 tons in 1971 to 240.000 tons in 1995 (a doubling of production 30 times). Since then, the UAE dates began to spread throughout the world where of the UAE dates is currently marketing in 68 countries worldwide.

What dies Khalifa International Date Palm Award represent to you?

Khalifa International Date Palm Award, its name carries the name of His Highness Sheikh Khalifa bin Zayed Al Nahyan, UAE President and this annual award for the researchers and specialists, producers, those involved in this sector and lovers of the blessed tree by His Highness the President raises the level of performance of employees in this sector in the world, a reward that carries the name of His Highness the Head of State is a great honor for us, and on this occasion I would like to present our deepest congratulations and blessings to His Highness Sheikh Khalifa bin Zayed Al Nahyan, UAE President and his brother, His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President, Prime Minister and Ruler of Dubai. And their brothers, Their Highnesses Supreme Council Members and Rulers of the Emirates, and to His Highness Sheikh Mohammed bin Zayed Al Nahyan, Crown Prince of Abu Dhabi and Deputy Supreme Commander of the UAE Armed Forces and the people of the UAE on the occasion of the Thirty-ninth National Day of the United Arab Emirates, wishing them Happy Returns, peace and security.

What is your advice to future generations?

I recommend every father to care about date palm tree, and let his children come closer to palm tree because of the blessing, nutrition, and I would advise those concerned to spread awareness about the importance of the blessed tree and promote a culture of maintaining Date Palm among the various groups in society, particularly through the introduction of date palm into curricula, and I hope that the nation's youth to learn the importance of palm varieties and ways of attention and care to date palm.

Photograph by: Khaled Al Fares

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Irradiation as alternative to MB in dates' production and processing

In the previous article, No.2 of the series of articles on alternatives to methyl bromide (MB) in dates' processing, we addressed the uses of low temperatures (refrigeration and freezing) and heat as physical alternatives for this ozone depleting substance. In the present article, we will address another physical alternative which is the use of irradiation technology.

Irradiation technology for food in general and dates in particular gained growing interest due to its close relevance to the food security file for countries and populations, the hot file which engage attention of the international community to fight poverty and malnutrition, especially in developing countries. This file is closely linked to agricultural production, the sector in which date production represents one of its pillars. Dates, like any other agricultural product, are characterized by seasonality and short term storage as it is perishable and undergo both quantitative and qualitative loss (i.e. amount produced, the nutritional value and quality characteristics) which are clear in case of soft and semi-dry varieties. Accordingly, irradiation is considered of the promising technologies that are increasingly adopted worldwide as highly effective preservation technique because of its efficacy in prolonging storage period and conservation of irradiated products, including dates.

Before we get exposed to findings of researches and trials conducted in some States to assess the effect of irradiation on sensory qualities as well as on chemical, physical and virtual characteristics of dates, it is important to clarify some related information, terminology and definitions that significantly contribute to reduce fears of adopting irradiation technology as alternative to MB for storage and

processing of dates. Irradiation is a physical treatment through which energy sources (rays of various types) are used to eliminate all different growth stages of pests using low doses that neither affects consumer's health nor the properties of treated product. Sterilization using irradiation is called cold sterilization where such treatment does not heat up the treated products. Irradiation includes the use of ionizing or non-ionizing radiation. Ionizing radiation is electromagnetic energy that generates electrically charged particles in treated products. Examples of these rays are Gamma rays, X-rays and accelerated electrons. Non-ionizing radiation, such as microwave radiation, is electromagnetic waves- or photons of energy less than 12 ev- that do not ionize the exposed materials or products.

Gamma and X-rays are of ionizing radiation highly efficient for use in quarantine because of the high penetration capacity into treated goods and products, taking into account that Gamma has more penetration capacity compared to X-rays. Gamma rays generate from Cobalt-60 or Cesium-137 and have energies above 100 keV and wavelength less than 10 picometers. X-rays are of wavelength in the range of 0.01-10 nanometers and energies in the range of 120 eV to 120 keV. Therefore, Gamma rays are shorter and have more applications in agriculture sector. Microwave radiations are of long wavelengths range from as long as one meter to as short as millimeter. Irradiation process includes two phases:

1. The first stage is a process of pasteurization of irradiated products using low dose to kill and reduce the number of lesions present on treated products and hence delay the spoilage or damaging of these products.

2. The second phase is the sterilization

Dates samples irradiated in plastic bottles

Dates samples irradiated in burlap sacks and foam plates

using higher doses of radiation to completely eliminate all growth stages of insect pests and microbes to prolong the storage period. Lethal effect of irradiation is due to changes in the nature of DNA molecules, cell membranes and enzymes in the living cell and thus disruption in critical cell functions leading to death of the pests.

When adopting irradiation technology for dates' treatment, it is essential to determine the radiation dose required. Radiation dose is the amount of energy absorbed by irradiated products. It is important that the minimum dose absorbed in the fruits is enough to kill all growth stages of all pests whereas the upper limit of the absorbed dose in fruits is less than the dose that could cause unwanted effects on sensual, physical, chemical and virtual characteristics of treated fruits. Radiation dose is measured by Gray (Gy) or KiloGray (KGy).

Irradiation technology plays an important role in agricultural development and in dates' industry in particular. In agricultural development, irradiation technology is used in many applications including but not limited to:

Prolonging the safe storing period and conservation of food and reduce losses estimated at about 25-30% of the total production as a result of infestations by insect pests and microorganisms.

Developing new plant varieties and genetic mutations for many purposes such as resistance to pests and some unfavorable climatic conditions such as high temperatures, drought and harsh soil conditions such as high salinity and low water availability.

Treatment of animal and poultry feed to prevent growth of aflatoxins-producing fungi that is lethal to animals when fed on such contaminated diets.

Certain radioactive isotopes such as nitrogen-15 and phosphorus-32 are used in plant nutrition-related studies for determining absorption rates of these nutrients. It is also used in studying nutrients' turn over in agricultural soils in order to rationalize and reduce the use of chemical fertilizers and hence reducing the costs of agricultural production, environmental pollution and protect human health.

In dates' sector, irradiation using one of the previously mentioned sources (of which Gamma rays and microwave energy are the most important) aims to:

Contribute to the food security of communities, particularly in developing communities by reducing postharvest losses of dates which in turn contribute in benefits optimization of production and reduce the gap between supply and demand and thus reduce both economic losses and price rates.

Securing consumers' food safety through providing insects/microbes-free dates. Insect injury of dates undoubtedly negatively affects consuming such dates and thereby increases dates' losses. On the other hand, microbial infection of dates where fungi are the most dangerous makes it more likely these dates contain aflatoxins that cause human diseases when consumed.

Prolonging storing period of dates with maintaining nutritional value, quality characteristics and marketing properties of different varieties.

Compliance with the requirements of regional and international trade that require pesticide-free products as well as quarantine requirements in accordance with laws and regulations of each State. This is to ensure imported dates are free of all forms of insect injuries and harmful microorganisms to prevent entry of such pests to the importing countries. It is noteworthy that some European countries have rejected some dates' consignments fumigated with MB.

Provide an alternative to MB that, as mentioned in previous articles, will be phased-out in developing countries by January 2015 and hence assisting States and Governments to fulfill their commitments to phase-out the use of this ozone depleting substance in accordance with the terms of the Montreal Protocol to protect the ozone layer.

The use of irradiation as safe replacement to different chemicals

used for treatment and fumigation of dates and hence ensures it is free of chemical residues which its cumulative effect causes many diseases to consumers' populations.

The need to find new means to resist infection with stores' pests and growing resistance to chemical pesticides which requires application of increased concentrations that has harmful influences to consumers.

Regarding the use of irradiation in the treatment of food products in general, the international food guide (FAO/WHO Codex Alimentarius Commission) indicated that the recommended irradiation dose for food products must not exceed 10 kGy (kGy= 1000 Gray) and that this dose is safe. The lethal effect of irradiation on pests and microbes is due to changes in the nature of the DNA, cell membranes, proteins and enzymes and thus disruption in cell functions that lead to death. Despite assurances and guarantees issued by the concerned bodies regarding safety of irradiated products, there are factors that face the spread of this technology including:

Public reluctance to consume irradiated dates for fear of negative health impacts and implications of these products.

Adopting application of such technology requires Ministerial decree and concomitant decisions and legislation governing the safety and security.

The need for high expertise in applications, practices and maintenance procedures.

Relatively high costs of irradiation treatment compared with other chemical treatments.

A lot of researches and experiments had been conducted on irradiation of dates using Gamma rays and microwave energy to eliminate pests and prolong conservation. With respect to applications of Gamma rays from cobalt-60 source, an experiment was conducted in Saudi Arabia by Dr. Hassan Al Qahtani and others on dates (var. Khalas) where fruits' samples artificially infected by saw-toothed grain beetle (Oryzaephilus surinamensis) other samples were infected by flour beetle (Tribolium confusum) while the third group of samples were infected by combination of the two insects (these insects infect the dates in stores). Dates fruits were then subjected to different doses of Gamma radiation (0.3 and 0.9 kGy). The results showed that exposing fruits to doses of 0.3 kGy was enough to kill populations in samples infected with one type of insects while exposing fruits to doses of 0.9 kGy were sufficient to kill insects in all samples infected either with one type of insect or with combination of both. Irradiation contributed in lowering the microbial populations in irradiated fruits for 6 months of storage. Regarding the effect of irradiation on sensory characteristics, the results showed that irradiation had no effect on treated fruits, however, proportion of sugars have relatively declined after treatment and increased gradually with increasing storage period. Also, during a regional workshop on alternatives to MB in dates sector organized by the Regional Office for West Asia of the United Nations Environment Program (UNEP/ROWA), held in December 2009 at Al-Khobar in Saudi Arabia, Eng. Ahmad Al Mashahadi indicated that treatment of dates with doses of 0.25 kGy prevented the development of eggs, larvae and the pupae of saw-toothed grain beetle, lesser and great date moth to the next stage and that the dose was lethal for full insect stage. He also indicated that this dose did not cause any changes in the nutritional value, taste or flavor of treated varieties (Sefri and Sokkari). With regard to microbial populations, Al Mashhadi indicated that doses of 4 to 6 kGy reduced numbers of microbes from 4.9 x 104 to less than 10 cell/gram in Al Shebi variety without affecting

the taste of treated samples.

Also, in the same workshop the writer, Prof. Mohsen El-Mohandes, presented his experiment carried out in 2008 (data not published) to assess the effect of Gamma irradiation (from cobalt-60 source, Atomic Energy Agency, Cairo) on dates fruits (siwei var., semidry dates) artificially infected by both full insect stage and larvae of flour beetle (Tribolium confusum). Dates samples were packed in different packaging materials (bags of kenaf, plastic bottles and foam) and irradiated with different doses ranged from 0.5 to 3.0 kGy. The samples were then kept in room temperature (28± 2 °C) with relative humidity of 60± 5%. Effect of treatment on insect populations was

estimated immediately after treatment as well as after 3 and 8 days post treatment while chemical properties were estimated for control and treated samples after 3 days of irradiation. The results showed that irradiation dose of 1.0 kGy did not achieve 100% death of insect immediately after irradiation but this ratio was achieved after 8 days storage under mentioned conditions. Irradiation dose of 2.5 kGy led to 100% death immediately after treatment. With regard to fruits' chemical properties, irradiation reduced the content of free phenols and total sugars in irradiated samples compared to the control untreated samples while reducing sugars content was increased in irradiated ones.

In other Egyptian experiment, Dr. Emam and his colleagues carried out an experiment on dates (var. Saeidi, semidry) to compare the impact of MB fumigation vs. irradiation (with doses of 1.5 and 3.0 kGy) on both physical, chemical and microbial characteristics as well as production of aflatoxins in samples stored for 8 months post treatment. The results showed that irradiation efficiency was greater

than MB, and both treatments caused certain loss of fruits dry weight. Also, significant effects were noted on fruits color, carbohydrates content (total sugars, reducing and non-reducing sugars) and sugar/acid ratio. Irradiation dose of 3.0 kGy was efficient than of 1.5 kGy in preventing growth of fungi and production of aflatoxins. The study recommended the use of 3.0 kGy dose as an alternative to MB for insects and fungal infection and poisons-free dates to prolong the storage period.

In Morocco, an experiment was conducted to irradiate dates' samples using Gamma radiation using doses of 0.6, 0.9, 1.8 kGy where chemical analysis was performed afterwards on irradiated and non-irradiated samples (control sample). The analysis was carried out immediately after treatment and after 4 and 8 months of storage in room temperature. Results showed no significant differences between samples in dry matter, fats and protein contents. However, amino acids and dry matter content were reduced in irradiated samples after 8 months of storage. Irradiation using dose of 0.9 kGy increased the proportion of total sugars and glucose while fructose remained unaffected in samples stored for 8 months.

In Iraq, Dr. Ayad Al Taweel and his colleagues carried out an experiment in which irradiation dose of 0.75 kGy from mobalt-60 source was used to irradiate packed dates samples. Based on quarantine laws and regulations, the study showed that irradiation was more efficient compared to MB treatment.

In Jordan, Eng. Fedaa Rawabdeh indicated that irradiating dates using 0.25 kGy stopped development of eggs and all life stages of saw-toothed grain beetle insect without affecting the nutritional value, taste and smell properties of dates samples stored for 12 months after treatment.

As for trials conducted on the use of microwave energy for dates disinfestations and eliminating polyphenolase enzyme, an enzyme causes the dates' color change to dark black during storage under freeze, an experiment was carried out on var. Zuhdi in Kamri, khalal and tamar stages as well as on var. Khadrawi in tamar stage only. Dates samples were exposed to microwave energy for

periods ranging from 10 to 60 seconds. Treated samples were allowed to reach the room temperature and then packed in polyethylene bags and stored. This treatment inactivated polyphenolase and peroxidase enzymes and prevented chemical and physical changes during storage.

In Tunisia, a study has been conducted to assess the use of microwave as an alternative to MB in controlling moth (Ectomyelois ceratoniae) as a requirement for dates (var. Deglet Noor) export to Western countries. Thermal properties, quality characteristics and effect on larvae in treated samples were examined. The results showed that microwave radiation was absorbed in soft

dates (25% moisture content) more than dry dates leading to higher temperature, indicating that fruit content of moisture has significant impact on heating efficiency and pests' killing. When dates of homogenous moisture content exposed to microwave for 55 seconds, the internal and external temperature of treated dates reached more than 52 °C and killed 100% of pest's larvae and eggs. On the other hand, exposing a mixture of soft fruits (25%) and dry fruits (13.5%) to microwave energy for 90 seconds heated soft dates to more than 100 °C while dry fruits temperature was less than the degree required to kill the insect larvae. The chemical analyses also showed that samples exposed to microwave energy did not differ in their characteristics from that of non-exposed samples (Tunisian Journal for plant protection, Issue 4, No. 2, 2009).

As for the use of electron beams, this new technology was applied in the sultanate of Oman on laboratory scale by Dr. Mansourah Al Amri (Ministry of Agriculture) and her colleagues to compare its effect in reducing

Deglet Noor dates in branches

pests' population and on quality characteristics of infested dates compared to other

treatments such as MB and microwave energy. The results indicated that the electronic beams reduced the microbial loads, maintained quality of treated samples and increased concentration of antioxidants compared with control treatment.

In conclusion, it is clear from the reviewed experiments carried out by researchers and specialists in different States that efficiency of irradiation technology in preventing insect incidence and preserving dates for longer periods without impact on product quality characteristics and properties has been demonstrated. It is also an environmentally-friendly technology with no residuals or environmental contaminants. When adopting irradiation technology for treatment of dates as an alternative to MB, it is necessary to determine (1) the lower dose of radiation, effective in killing all insects associated and various growth stages, that does not affect chemical and physical properties as well as quality and marketing characteristics of treated varieties and (2) the economic feasibility of irradiation and cost compared to other treatments, particularly MB.

Accelerator

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Inventory of insects in Ziban oases Biskra, Algeria

Abstract

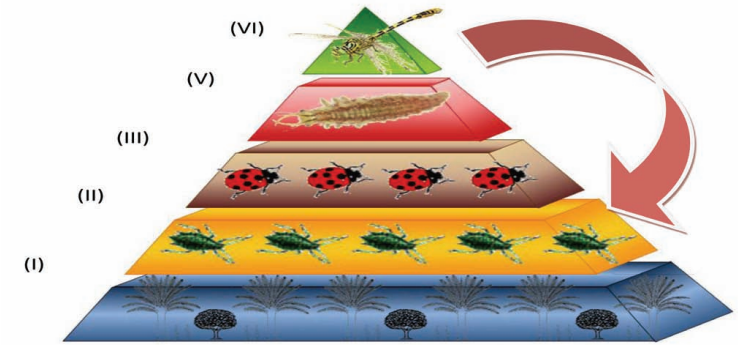
An inventory was carried out in five stations in the oases of Ziban, characterized by the high quality of their dates, in order to study the relationships between the oases ecosystem and insect fauna inhabiting it. Specimens were sampled through pitfall traps made with half plastic bottles containing Ethylene preservative solutions. A total of 115 species were collected, during 5 months of survey, belonging to 61 families and 17 orders in different classes: 12 into Insecta, 3 into Arachnida, one into Chilopoda and one into Isopoda. The most represented insect orders are Coleoptera (44.42%), Hymenoptera (20.86%) and the Lepidoptera (7.87%), all in the 3 major ecological groups of phytophagous (41.73%), zoophagous (36.52%) and omnivorous (21.73%) insects. Among the most important beneficial zoophagans collected in our oases ecosystem, there are predators (Coleoptera) and parasitoids useful in the bio-control; Diptera or Hymenoptera. Despite the large number of species collected and the relationship existing between the various ecological groups, our study is just the first step in the description of the oases entomofauna that deserves to be continued.

Keywords: Ecosystem, insects, Ziban oases, inventory, ecological groups.

Résumé

Dans les oasis des Ziban, cinq stations qui se caractérisent par la haute qualité des dattes produites, ont fait l'objet d'un inventaire, afin d'étudier les relations entre l'écosystème oasien et l'entomofaune qui y habite. Les exemplaires ont été échantillonnés en utilisant des pièges à fosse (pitfall traps) faits avec des demi-bouteilles en plastique contenant des agents conservateurs à base d'éthylène. Pendant les cinq mois d'inventaire, 115 espèces ont été collectées, appartenant à 61 familles et 17 ordres

Figure 6: Schematic description example of trophic chain in oases ecosystem



de différentes classes : douze Insecta, trois Arachnida, un Chilopoda et un Isopoda. Les ordres d'insectes les plus représentés sont les Coléoptères (44,42%), les Hyménoptères (20,86%) et les Lépidoptères (7,87%), tous compris dans les 3 principaux groupes écologiques des phytophages (41,73%), des zoophages (36,52%) et des omnivores (21,73%). Dans cet écosystème oasien, parmi les zoophages les plus importants il y a des prédateurs (Coléoptères) et des parasitoïdes très utiles dans la lutte biologique; les Diptères ou les Hyménoptères. Quoi qu'il en soit, en dépit du grand nombre des espèces collectés et les relations existantes entre les différents groupes écologiques, notre étude n'est que le début de la description exhaustive de toute l'entomofaune présente dans les oasis, qui mérite d'être poursuivie.

Mots clés: Ecosystème, insectes, oasis des Ziban, inventaire, groupes écologiques.

Introduction

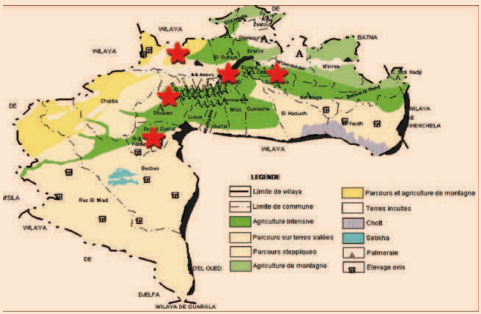
Insects are everywhere, in fact, there are more insects than any other type of animal on earth (Center for ecosystem survival, 1996). They are presumed to constitute about three-fourths (3/4) of all living animals on earth (Speight et al. 2008). Widely divergent estimates of insects in the world have been provided including up to 30 million species (Erwin 1982), 12.5 million (Hammond 1992) and 5-15 million (Stork 1997). More startling still is the simple fact that less than a million species have actually been described; and large majorities of the non- described species are in the third world. Existing knowledge on insect biodiversity is poor and no one knows exactly how many species of insects exist. It is important to have an idea about the living insects in each ecosystem and to be able to recognize the relationships existing between them.

In our oases ecosystem, hot dry climate, specialized insects found optimal conditions for their development. Their ecology is of crucial importance to oases ecosystem function and very often they are economically important as pests of crops, vectors of disease, beneficial components of food webs, and vital components of pollination systems.

Due to the lack of information -The latest inventory was carried out by LeBerre in 1978- on the species of insects present in the oases ecosystems in Algeria (Ziban), despite some scattered scientific observations conducted all over the country, there is still a shortage of informations to be completed on the inventory in Algerian oases ecosystem.

It is urgent today to face this alarming situation by having as 1st step an inventory, and alternative control methods of pests on date palm and also to take a account of the fragility of this microclimate ecosystem, by respecting the environment as well as the health of the consumers, since date marketing is often confronted with the

Figure 1: Map of study sites location.



problems of chemical residues, it is not a question of eradicating pests but of limiting their effect and damage.

Materials and methods

The study work was conducted at the oases of the "Biskra" wilaya located in the east of "Algeria", south of the Aurès Mountains.

The region of "Biskra" (Ziban) was selected as a site for this research because it is one of the most important areas of date production in "Algeria". The survey was conducted in five oases (Fig 1); Ain Ben Noui, Tolga, El Ghrous, Ouled Djellel and Sidi Okba which are known as the best oases producing high dates quality "Deglet Nour" in Algeria.

In order to have an idea about the species that can be present in those chosen cultivated area we used traps.

Pitfall traps were used for collecting specimens (Fig 2). These traps were made up of plastic containers with holes in the bottom, with a cover of wire mesh and stones placed approximately 2,5cm above the plastic container in order to protect the traps from rainfall and prevent mammal species from entering.

Four (4) traps were used per site starting from the first of February until the end of June and were visited every week. The location of these traps is probably best in four opposite directions in order to cover all the insect movement in each station. And in situations where ground vegetation is minimal or relatively rare traps can be left unattended for a week or more without deleterious effects up on any specimens captured (Greenslade 1973).

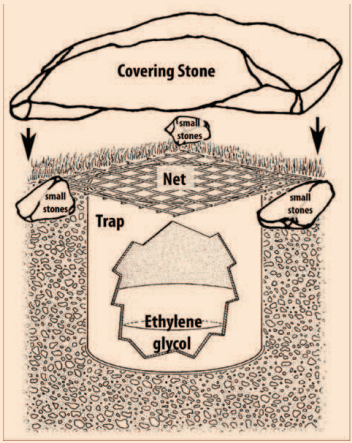
The captured insects were collected weekly and transferred to the laboratory, where they were counted, and examined. Once back in the lab, insects were sorted and pinned or point mounted. After all of the insects were pinned, they were then identified to order, family and in the major cases in species. Then they were given collection labels for the storage on boxes.

For our survey, the identification of insects took place mainly after capture in the laboratory under the microscope or magnifier. However, some species require further examination to be identified. This is a task for taxonomists; nevertheless an identification of oases insects up to the genus or species level was made at the University of Biskra and C.R.S.T.R.A based on their reference collection and using books (Chinery 1993) and finally corrected by the professor porcelli. Some of the prepared and identified species were sent to Algerian entomologist to confirm identification. Once insect is in a position facilitating the study of external characters, it is essential the label (Phillip et al. 1981), to associate the word Information regarding the origin and identity the specimen, This information is written on one two or three labels pinned under the specimen or on a special paper for insects in alcohol and on slide. Pinned specimens are kept in specially made insect store-boxes, lined at the bottom with paper-covered cork and having removable glass lids.

Results and discussion

Consisting of 20 samples/site, that is to say 100 samples/5 sites. The pitfall traps collection method yielded a total of 1 524 arthropods. From the total number of arthropods (1 524 individuals) collected from the five (5) sites (Fig 3); the mean number of specimens sampled (per trap) was the highest for the El-Ghrous station with 352 specimens, then for Tolga with 335 specimens, in the 3rd position with 333 specimens was Ain Ben Noui site, in the fourth position with 257 specimens came Ouled djellel site and finally Sidi Okba site with 247 specimens. It was proposed that vegetation has a threefold influence on the diversity (species-richness) its effects on microclimate, carrying capacity and structural complexity of

Figure 2: Pitfall trap scheme.



the habitat (Greenslade and Greenslade 1977).This variation on number maybe explained by the diversification on flora during the spring period that our insects used as habitats to search for prey for an alternative source of food, for microclimate more favorable than the cultivated field or to find a refuge or hibernation site and for some, an undisturbed site for larval development (Maisonhaute 2009).

The number per order was the highest for the Coleoptera order with 677 specimens; then the Hymenoptera order with 318 specimens, followed by the Lepidoptera order with 120 specimens. The other orders are represented by 3 to 26 specimens. Ye and Li (2003) carried out similar work in studies conducted in Singapora in three different ecosystems, concluding that the dominant order found in their pitfall traps were especially from the insecta class (Coleoptera, Hymenoptera, Lepidoptera,…). Thus, the design of the pitfall trap could be based towards these arthropods. Another possible explanation for such an observation may be explained by the functional role of the crawler arthropods (Didham et al. 1998). Pitfall trapping, as the name implies, involves the capture of ground surface-active arthropods that fall into a pit-like trap sunk into the ground. Moreover, the abundance, richness and diversity of beetles (Coleopteran) increased with increasing diversity of weeds (Burgio et al. 2006).

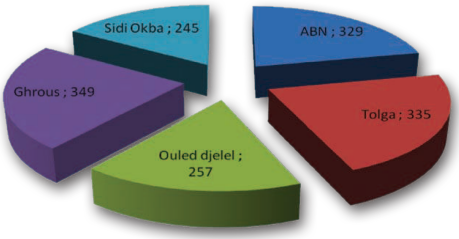
Also for those obtained results, pitfall traps have been shown to be highly efficient in the studies of the occurrence and activity of invertebrates active on the ground surface, especially beetles and spiders (Greenslade 1971 and Luff 1975). In addition Spence and Niemelä (1994) and Niemela (1996), examined variety of methods (5 different methods) of sampling, in general they found that pitfall trapping caught the large bodied individuals (Coleoptera and scorpions) whereas smaller sized species were caught in the litter washing.

The efficiency of the pitfall traps used played an important part in the experimental set-up. Factors such as the size (20 cm of diameter), material of the cup (plastic bottles) and depth of trap (20 cm) may be based towards certain arthropods that are too big to be captured by this type of traps (Luff 1975; Work et al. 2002), we can give (Lepidoptera and Odonata) as examples. Whereas others like Maehara (2004) and Scudder (2000) disagree with this explanation and they thought that the efficiency of pitfall traps was correlated with the density of beetles, but not to the size of used containers. Generally, if a single trap type is used to sample a fauna over a period of time, apparent dominance or relative abundance of the species caught will depend on its activity, density and the extent to which it is caught by that trap type (Luff 1975). In our case this may be one of the reasons which explain the relative abundance of certain arthropods (Coleoptera, Orthoptera and Diptera orders) present in large number in certain oases (Spence and Niemela 1994).

In total seventeen (17) orders of Arthropods were identified from the collection of 115 species, including 12 orders of class Insecta, three (3) orders of the class Arachnida, one order of class Chilopoda and one order of class Isopoda (Table 1).

The most frequently collected individuals and the individuals collected in the greatest quantities were found in the insecta class (Fig 4). In total, 12 orders of insecta class were

Figure 3: Total collected specimens per stations.



identified including 51 families and 103 species.

For all stations we found that, Coleoptera order with 44,42% represented the highest percentage, Hymenoptera with 20,86% and Lepidoptera represented with 7,87%, are the three most abundant groups of arthropods collected. Where Coleoptera order in Carabidae, Tenebrionidae and Coccinellidae families. Comparing to the results reported by Baumgardner (2007), who found that the collection was dominated by the order Coleoptera (beetles) at 41% of the collection and 287 total specimens. This is somewhat higher than expected since it is estimated that 33% or 1/3 of all insect species worldwide are of the order Coleoptera.

The next most numerous order after Coleoptera was Hymenoptera order in the Vespidae, Apidae and Formicidae families. In third (3rd) position order Lepidoptera in the Pieridae and Nymphalidae families, for the order Heteroptera we have both the Miridae and Pentatomidae families and so our results agree with those of Winchester and scudder (1993) who tried several methods to capture insects' specimens and they found that some of them are mostly presents in pitfall traps type.

The others orders were represented by few species belonging to one to two families respectively; Neuroptera (Chrysopidae) and Dermaptera (Forficulidae; Labridae).

For class Arachnida, orders Araneae (Lycosidae), Solfugidae (Daesiidae) and Scorpions (Scorpionidae) are the three greatest orders represented by several species.

From the 115 species, six (6) of them are listed by the Ministry of Land, Environment and Tourism as protected species in Algeria: Apis melifera; Xylocopa violacea, Syrphus sp, Mantis religiosa, Chrysopa carnea and Polistes gallicus (M.A.E.T 2009 at press).This is may be due to their importance as predator or parasitic species that have an effect on the regulation of crop pests (Mantis religiosa, Chrysopa oculata) or a beneficial effect on the environment (Apis melifera).

Many of the 115 recorded and identified species are phytophagous; overall there are species that are predatory and parasitic (36, 52%), but we are aware of the phytophagous (41,73%) because they often compete with us for cultivated plants (Fig 5).

Among the sixty-one (61) families collected there are a number of serious plant pest as for the order of Homoptera (Aphididae), Lepidoptera (Tuta absoluta) which is a newly recorded species in 2009 on greenhouse tomatoes. Heteroptera (Nezara viridula) and also Orthoptera (crickets) are generally abundant, widespread throughout the country and recognized as excellent indicators of the integrity of terrestrial ecosystems.

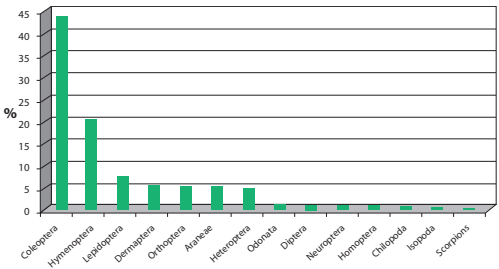
Because not all insects are pests, they are also beneficial. Zoophagous species can be divided in two major groups the beneficial flies include parasitic like the Tachinid flies and predators like the Syrphid fly and coccinellidae.

Among the most important Zoophagous collected in our oases ecosystem and that are, beneficial (predators) insects are ladybird beetles (Coccinella septempunctata L., 1758), lacewings (Chrysopa oculata, say 1839), praying mantids (Mantis religiosa, L., 1758) and dragonflies (Sympetrum sanguineum, Muller, 1764). The parasitic species are Diptera fly (Peleteria varia fabricius, 1794) and Hymenoptera (Megascolia maculata Drury, 1773).

The relationships between pests and natural enemies (parasites, predators) are extremely complex, they have proven difficult to analyze, and in many cases are still poorly understood. Actually, some zoophagous insects are needed to keep the natural enemies population alive, by setting up; insect functions, insect' life cycles and their natural enemies. The third group that was found in our pitfall traps (oases ecosystem) is the polyphagous group that includes the Coleoptera (Pimelia sp), beetles (Brachinus explodens, Duftschmid 1812) and ants (Messor Barbarus, L.).

Communities are groups of organisms (populations) that maintain persistent associations with each other. In our case, we dedicate that there are

Figure 4: Total collected specimens per order.



relationships between organisms living in the same agro ecosystem that can be modified once it is disrupted by the unavailability of one link. Predators and prey occupy different trophic levels, whereas parasites and hosts sometimes exist on the same resource plants, if they compete for host resources rather than consume host tissue (Raffel et al. 2008). The large number of predatory Coleoptera, genus Coccinellidea, present in all visited stations during the period between March and May with the role of regulator of Aphids population, can be eaten by several others insects that could be present in and around the oases (Chrysoperlea oculata). The Libellulidae family is well represented in our oases ecosystem by the dragonfly that has major role in the regulation of predators' species. In addition the presence also of the Araneae in the tow oases station Tolga and El Ghrous is very attractive and can explain the species diversification in this region. Starting from the information collected during our survey, we can build our chain in the oases ecosystem in this way.

Integrated Pest Management is an approach to pest management designed to manage pests and diseases with as little damage as possible to people, the environment and beneficial organisms (Dufour 2001).

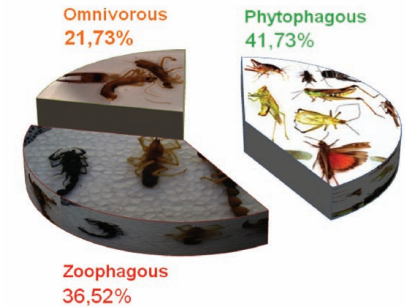
The goal of IPM is to maintain a balanced ecosystem (a healthy environment) which results in high economic, environmental, and social benefits (Dufour 2001). The objectives of ecosystem analysis are to make decisions about what to do to manage the oases ecosystem and to achieve the goals of IPM.

An IPM program was applied in oases ecosystem by Doumindji and Doumindji-Metiche in 1990, and they had results of 45.3% success with the release of ooparasite Trichogramma embryophagums as a parasite of Ectomylois ceratonae Zeller, in an oasis ecosystem in south-west Algeria. Another work was carried out in some oases of south-east Algeria where I.N.P.V. released some sterilized males of Ectomylois ceratonae Zeller in 1999 and obtained a significant reduction in worm infestations of dates.

Another experiment of Quinlan and Dhouibi (2008), that consist on field releases of biological control agents against date moth, other than B.t., include the Bracon hebetor and other parasitoids and predators has great efficiency but still under search in field.

Some of results were achieved in oases ecosystems of the Algerian south-west in 2008 by Idder and Pintureau who used lady bird (Stethorus punctillum) as a predator that played an important role in the control of the mite O.afrasiaticus. Other predators,

Figure 5: Percentage of ecological groups.



however, are present in Algeria; they will have to be tested in order to establish a method of biological control suited to sufficiently protecting the palm plantations against O. afrasiaticus, and other pest which infest our crops.

Finaly, this inventory is a first approach in any event and is a tool for setting up an IPM program within oases ecosystem based on the correct identification of collected species and the ecological role that play in trophic food chain.

This study will allow the state to obtain a list for the conservation and classification of insects through the creation of insectariums for the conservation of the collected insects, that will prevent the entry of large numbers of new species in the future, such as Rhynchophorus ferrugineus and Phoenicoccus marlatii that can affect our oases ecosystem (Date palm).

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Figure 2: Total collected species by pitfall traps in oases ecosystem

Class	Order	Family	Species	Ecological role			Months				
				A	B	C	2	3	4	5	6
INSECTA	COLEOPTERA	Cetoniidae	*Tropinota (epicometis) hirta* (Poda, 1761)		X						
			Tropinota squalida (Scopoli, 1783)	X							
		Coccinellidae	*Psyllobara vigintiduopunctata* (L, 1758)	X							
			Chilocorus bipustulatus (L, 1758).		X						
			Stethorus punctillum		X						
			Coccinella septempunctata (L, 1758)		X						
		Buprestidae	*Agrilus scythicus*		X						
		Tenebriooidea	*Pimelia payraudi* (Latreille, 182)	X	X						
			Diaperis maculata Olivier 1791								
			Gonocephalum granulatum nigrum (Küster, 1849)		X						
			Blaps sp (Fabricius, 1775)		X						
			Coeloctenema obesa (LeConte, 1851)								
		Aderidae	*Anidorus sanguinolentus* (Gotz, 1783)		X						
		Carabidae	*Calosoma inquisitor* (L, 1758)			X					
			Carabus sp.		X	X					
			Brachinus explodens (Duftschmid 1812)		X						
			Lophyra flexuosa (Fabricius, 1787)		X						
			Anthia duodecimguttata		X						
		Dasytidae	*Psilothrix viridi coerulea* (Geoffroy, 1758)		X						
		Scarabaeidae	*Macrodactylus subspinosus* (F)		X						
			Anomala marginata (F).	X							
		Curculionidea	*Larinus sp*	X							
			Liophloeus tessulatus (Müller, 1776)		X						
		Chrysomelidae	*Clytra* sp.	X							
		Meloidae	*Mylabris bipunctata* (L, 1767)								
	HYMENOPTERA	Vespidae	*Polistes gallicus L;* .	X	X						
		Colletidae	*Colletes sp*	X							
		Megachilidae	*Megachile rotundata*	X	X						
		Ichneumonidae	*Dusona sp*		X						
			Netelia sp.		X						
		Scoliidae	*Megascolia maculata* (Drury, 1773)	X	X						
		Apoidea	*Apis mellifera* L	X							
			Xylocopa violacea (L, 1758)	X							
		Formicidae	*Formica incerta*	X							
			Camponotus sp			X					
			Messor barbara (L)			X					
		Myrmicinae	*Solenopsis invicta Buren*		X						
		Pompilidae	*Arachnospila sp.*		X						
		Braconidae	*Phanirotoma sp*		X						
	HEMIPTERA	Pentatomidae	*Codophila varia* (Fabricius, 1787)	X							
			Nezara viridula (L, 1758).	X							
			Perillus bioculatus (Fabricius)	X							
			Acrosternum heegeri (Fieber, 1861)	X							
			Dolycoris baccarum (L 1758).	X							
			Eurydema ornata	X							
			Ancyrosoma leucogrammes	X							
			Pentatoma rufipes (L, 1758).	X	X						
			Carpocorpuris purpureipennis (DeGerr 1773)	X							
		Miridae	*Stenotus binotatus* (Fabricius 1794)	X							
		Lygaeividae	*Oxycarenus lavaterae* (fabricius, 1787)	X							
		Cydnidae;	*Sehirus luctuosus* (Mulsant & Rey, 1866)	X							
		Stenocephalidae	*Dicranocephalus Albipes* (Fabricius, 1781)		X						
	DIPTERA	Syrphidae	*Sphaerophoria scripta* (L.,1758)		X						
			Cheilosia variabilis (Panzer, 1798).								
			Syrphus vitripennis (Meigen, 1822)		X						
			Melanostoma mellinum (Ll, 1758).		X						
		Tipulidae	*Tipula paludosa*								
			Dusona sp	X	X						
		Bombyliidae	*Systoechus vulgaris* (Loew, 1863)	X	X						
		Asilidae	*Neoitamus sp.*	X	X						
		Berytidae	*Metatropis rufescens* (Herrich-Schäffer, 1835)			X					
		Tachinidae	*Campsilura concinnata* Meig		X						
			Peleteria varia (Fabricius, 1794)		X						
		Sphingidae	*Hyles lineate* (Fabricius, 1775)	x							
		Noctuidae	*Mythimna vitellina* (Hübner, 1808).	X							
			Lacanobia aliena (L, 1767)	X							
			Orthosia gothica (L, 1758)	X							

	LEPIDOPTERA	Nymphalidae	*Pararge aegeria* (L, 1758).	X									
			Araschnia levana (L, 1758).	X									
			Vanessa cardui (L, 1758).	X									
			Danaus plexippus (L, 1758)	X									
		Pieridae	*Pontia daplidice* (L, 1758)	X									
			Pieris rapae (L, 1758)	X									
			Lycaena helle (Denis & Schiffermüller, 1775).	X									
			Euchloe simplonia (Freyer, 1829).	X									
		Lycaenidae	*Glaucopsyche melanops*(Boisduval, 1828).	X									
			Polyommatus semiargus (Rottenburg, 1775).	X									
		Sphingidae	*Macroglossum stellatarum* (L, 1758)	X									
		Geometridae	*Idaea fuscovenosa* (Goeze, 1781)	X									
		Gelechiidae	*Tuta absoluta* (Meyrick, 1917)	X									
			Euchloe (Elphinstonia) lessei zagrosicus	X									
	HOMOPTERA	Aphididae	*Myzus percecae* (Sulzer)	X									
			Rhopalosiphum podi (L)	X									
			Hyadaphis foeniculi (Passerini, 1860)	X									
		Diapanosiphinae	*Therioaphis trifolii* (Monell)	X									
	ODONATA	Libellulidae	*Sympetrum sanguineum* (Muller, 1764)		X								
			Sympetrum vulgatum (L, 1758)		X								
		Coanagrionidae	*Coenagrion sp*		X								
			Ischnura elegans (Vander Linden, 1820)		X								
	DERMAPTERA	Labidriidae	*Labidura riparia* (Pallas, 1773).										
		Forficulidae	*Forficula auricularia* (L, 1758)		X								
	EPHEMEROPTERA	Baetidae	*Cipeon dipterum* (L 1761)		X								
	NEUROPTERA	Chrysopidae	*Chrysopa oculata* (say 1839)		X								
	ORTHOPTERA	Acrididae	*Chorthippus sp.*	X									
			Aiolopus strepens (Latreille,. 1804)	X									
			Acrida turrita (L, 1758).	X									
			Chorthippus biguttulus (L, 1758).	X									
			Melanoplus bivittatus										
			Locusta migratoria (L.)				X						
			Acrotylus insubricus(Scopoli, 1786).	X									
		Gryllidae	*Gryllus bimaculatus* (De Geer, 1773)	X	X								
	MANTODEA	Mantidae	*Mantis religiosa* (L, 1758)		X								
			Sphodromantis viridis (Forskal 1775)		X								
	ARANEAE	Lycosidae	*Trochosa terricola* (Thorell, 1856)		X								
		Dysderidae	*Dysdera crocata* C. L. Koch, 1838		X								
		Thomisidae	*Tomisus sp.*		X								
ARACHNIDA		Aranaidae	*Agalenatea redii*, 1763		X								
			Argiope bruennichi (Scopoli, 1772)										
			Argyope lobata (Pallas, 1772)										
		Theridiidae	*Latrodectus sp*		X								
	SOLFUGIDAE	Daesiidae	*Syndaesia sp*										
	SCORPIONS	Buthidae	*Buthiscus bicalcaratus* (Birula, 1905)		X								
		Scorpionidae	*Androctonus bicolor* (Hemprich & Ehrenberg, 1828)		X								
ISOPODA	**ONISCIDAE**	Porcellionidae	*Porcellio scaber* (Latreille, 1804)			X							
CHILOPODA	**GEOPHILOMORPHA**	Scutigeridae	Centipede			X							

Regeneration and analysis of genetic stability of plantlets as revealed

by RAPD and AFLP markers in date palm (Phoenix dactylifera L.) cv. Deglet Nour

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The two first authors have contributed equally in this work: Othmani for in vitro culture and RAPD analysis; Rhouma for AFLP analysis

Abstract

The 2,4-Dichlorophenoxyacetic acid induced somatic embryogenesis of Tunisian date palm (Phoenix dactylifera L.) cultivar, Deglet Nour and analysis of the true-to-type conformity of the derived plantlets were investigated in this study. For this purpose, two polymerase chain reaction (PCR)-based methods namely, randomly amplified polymorphic DNA (RAPD) and amplified fragment length polymorphism (AFLP) markers were used. Data proved that the modified Murashige and Skoog (MS) media including 1, 10 and 100 mg.l-1 2,4-Dichlorophenoxyacetic acid have permitted an intensive callogenesis when leaves are incubated in dark. Subcultures on MS medium supplemented with 0.1 mg.l-1 2,4- Dichlorophenoxyacetic acid stimulated a rapid maturation of somatic embryos in light. A mean of 120 somatic embryos were developed from 0.5 mg callus within 3 months. Embryos germination and conversion to plantlets were successfully achieved after transfer to free plant growth regulators MS medium. On the whole, 75% progenies survival was established in soil.

In addition, RAPD and AFLP analyses were performed in 180 randomly selected plantlets. The resultant DNA banding profiles exhibited similarities between the mother plant and its progeny. This result strongly supported the true-to-type nature of the in vitro derived progenies in date palms.

Keywords Amplified fragment length polymorphism (AFLP), Date palm, plantlets, Random Amplified Polymorphic DNA (RAPD), plant regeneration, somatic embryogenesis

Abbreviations: 2,4-D, 2,4-Dichlorophenoxyacetic acid; IBA, Indole-3-Benzylaminopurin

Introduction

The date palm (Phoenix dactylifera L.), (2n=36), an out-breeding heterozygous dioecious perennial monocot is characterized by large genetic diversity. This fruit crop is of great importance in the oasis development not only for date production but also for the maintenance of socio-economical and environmental stability of the arid areas. Due to its out-breeding and heterozygous nature, date palm progenies consisted of 50 % of male trees and 50 % of females that are not true-to-type (Carpenter and Ream 1976). Therefore, its conventional propagation is made by offshoots. However, this method is very limited in time and in number to establish new date palm plantations. Moreover, several genotypes did not produce offshoots and those issued from other cultivars are difficult to root. In addition, seed-propagation palms do not bear true to type and required up to seven years before fruiting stage. In order to overcome these hybridization difficulties, in vitro multiplication methods have provided alternative strategy either for mass propagation of elite cultivars or for date palm improvement. For instance, somatic embryogenesis is reported to be a relatively consistent strategy for genetically homogeneous plant micropropagation (Kanita and Kothari 2002). It should be stressed that since in vitro culture may cause disturbances in the genome organization of regenerated plantlets inducing somaclonal variation (Larkin and Scowcroft 1981) conformity of the derived plants constitutes the main criteria for large scale use particularly for new groves establishment. Therefore, certification of the derived plants' conformity is required. For this purpose, different methods have been reported and described the use of the Williams et al. (1990) random amplified polymorphic DNA (RAPD) and the Vos et al. (1995) amplified fragment length polymorphism (AFLP) methods have been reported as reliable, quick and inexpensive procedures to identify clones and cultivars and to assess somaclonal variation (Taylor et al. 1995; Trifi et al. 2000). The present study portrays the achievement of the in vitro propagation of the Tunisian date palm elite cultivar, Deglet Nour, through somatic embryogenesis and the assessment of derived progenies' certification using RAPD and AFLP markers.

Materials and methods

Plant material

Juvenile leaves of 1-3 cm in length sampled from 20 years old date palm cv. Deglet Nour were used. These were randomly collected from trees growing in plantations at El Mahassen located in the south of Tunisia. 180 somatic embryo-derived plantlets produced in different media as well as the mother tree were used to carry out the designed analyses.

Tissue culture Media and culture conditions

Leaf sections of 1 cm2 were sterilized by soaking in 0,01 % HgCl2 for 1 hour, three times washed in sterile distilled water and cultured on different MS media (Murashige and Skoog 1962) containing 5 % of sucrose (w/v) and 0.7 % of Difco agar (w/v). As reported in Table 1, 0.0, 1.0, 10, and 100 mg.l-1 of 2,4-D were added to M1, M2, M3, and M4 media respectively.

The pH was adjusted to 5.7 prior to autoclaving at 1.4 Kg cm-2 for 20 min. Production of callus from explants was accomplished via incubation of cultures in the dark at 28 ± 2 °C and regular subculture at an interval of 6-7 weeks for 4-5 months under the same culture conditions. Experiments consisted of at least 25 cultures per treatment and were repeated three times.

For testing differentiation of embryogenic callus, the entire expanding explants with resultant embryogenic callus were transferred to MS medium supplemented 1 mg.l-1 2,4-D. Cultures were placed in air-conditioned culture room at 28 ± 2 °C with 16/8 h photoperiod providing 80 µmol m-2 s-1 fluorescent light and subcultured every 1 month.

To regenerate plantlets, matured somatic embryos were picked from maturation medium after 2 months of culture and transferred to free plant growth regulators MS medium without any postmaturation treatment. Transfer of plantlets to free-living conditions was made as follows: plantlets are carefully removed from agar medium avoiding the root system damage and washed in distilled water for 15 min to remove excess adhering media and to avoid their dehydration. Plantlets were than rinsed three times using distilled water, sprayed with 0.5% benomyl fungicide solution and transferred to soil.

DNA extraction

Total cellular DNA was isolated from the young leaves according to Dellaporta et al. (1983). Quantification and integrity of the resultant DNAs was spectrophotometrically performed using a GeneQuant spectrometer (Amersham, Pharmacia, France) and analytic agarose gel electrophoresis according to Sambrook et al. (1989), respectively.

Primers and RAPD assays

Nine universal primers purchased from Operon (Alameda, USA) identified as OPA04, OPA07, OPA16, OPC07, OPD05, OPD06, OPD16, OPD19 and OPE16 were used to perform RAPD amplifications (Table 2). These oligonucleotides have been reported to generate reproducible amplification and revealing inter varietal polymorphisms within date-palms (Ben Abdallah et al. 2000).

Amplifications were conducted in a total volume of 25 µl including: 60 ng of total cellular DNA (~1 µl), 150 µM of dNTP (dATP, dGTP, dCTP and dTTP), 3 mM of $MgCl_2$, 30 pM of primer, 2.5 µl of Taq DNA polymerase buffer (10×), 1 U of Taq DNA polymerase (Amersham, France). Mixtures were firstly heated at 94°C during 5 min as a preliminary denaturation step before entering 45 PCR cycles including each one: 30 seconds at 94°C for the denaturation, 1 min at 37°C for primers' hybridization and 2 min at 72°C for complementary strands synthesis.

A final elongation during 10 min is usually programmed at the end of the last amplification cycle. PCR products are electrophoresed by loading 12 µl of each reaction in 1.5 % agarose gel using TBE (1×) buffer during 2 h, stained with ethidium bromide and visualized under UV transilluminator (Sambrook et al. 1989).

Primers and AFLP assays

Primers used in this study and AFLP assays were performed as reported in Rhouma et al. (2007). Six set primers were tested in this study. These are identified as follows: EAAC/MCAA, EAGC/MCAA, EAAC/MCAG, EACA/MCAG, EACC/MCTA, EAAC/MCAT. ENNN/MNNN where E and M correspond to the EcoR1 and Mse1 restriction enzymes respectively.

The AFLP banding patterns were electrophoresed on denaturing polyacrylamide gels (6%) and visualised after silver staining according to Chalhoub et al. (1997).

Results and discussion

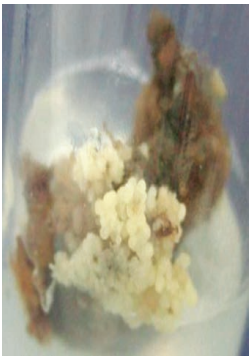
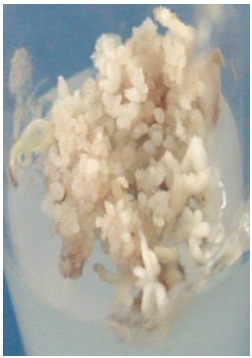
Callus production, differentiation and plant regeneration

Depending on the concentration of the 2,4-D, different morphogenetic responses were scored from leaf explants cultured during five months. Note worthy that explants of 1cm2 size exhibited irregular growth and died after 8 weeks of culture when cultivated on MS medium deprived of 2,4-D. Juvenile leaf pieces have initiated, however, friable calli, showing miniature (< 2 mm) white nodules when cultivated on the medium M2 (Fig. 1a). In fact, these calli appeared either on the upper or the lower surface of the explants. Similar results have been reported in date palms (Drira and Benbadis 1985). Our data therefore concur with the efficiency of the 2,4-D as a callus-inducing agent in this crop. In addition, direct embryogenesis was induced on this medium (i.e. M2) at the basic part leaves without any callus development (Fig. 1b). Therefore, we assume that the 2,4-D is very efficient to promote callus growth without any somatic embryos on the callus either on similar media or on those used for subculture. However, decrease of 2,4-D concentration till to 0.1 mg.l-1, has permitted to induce embryogenic calli. These have proliferated normally and yielded an average of 45 elongated somatic embryos per 0.5 g fresh weight of embryogenic callus (Fig. 1c). As illustrated in figures 1c and 1d, maturation and germination of the derived embryos have been successfully achieved when the 2,4-D is completely removed from the culture medium. Such results have been reported somatic embryos of other plants as Momordica charantia (Thiruvengadam et al 2006), and oil palm (Aberlenc-Bertossi et al 1999).

Juvenile leaf explants were also able to produce embryogenic callus more efficiently on M3 medium than on M2 medium. Indeed, the frequency of callus induction on M3 medium was 45% on average vs. 30% on M2 medium. It should be stressed that explants cultivated on the MS medium supplemented with 100 mg.l-1 2,4-D (M4) turned regularly to brown and most of them died. However, addition of activated charcoal to the nutrient medium has permitted to neutralize these phenomena and to enhance the explants' endurance and their ability to embryogenic callus with a frequency of 20%. This is in agreement with properties of this adsorbent in the decrease of the toxic browning of explants and the plant embryogenesis process as reported by Touchet (1991) and Sharma et al. (1980).

These were developed into matured stage (Fig. 1d) and germinated when the 2,4-D was completely removed from the culture medium. These results confirm those from by Thiruvengadam et al. (2006), with somatic embryos of Momordica charantia L and by Aberlenc-Bertossi et al. (1999), with somatic embryos of oil palm.

The derived plantlets (Fig. 1e) were hardened through growing in ½ MS liquid medium supplemented with 1mg.l-1 IBA. Prior high intensity illumination incubation in this medium was necessary before their transfer to a soil mixture (Fig. 1f). Finally, regenerated plants were transferred to non-sterile conditions for acclimatization and to conditions of gradual decrease of humidity levels. According to these conditions, 80 % of plantlets have easily subsisted during one month and their transfer to soil field conditions was successfully achieved (Fig. 1G).


Plantlets stability as revealed by molecular markers

In order to examine the genome stability of the derived plantlets, we have designed two PCRDNA based methods: the random amplified polymorphic DNA and the amplified fragment length polymorphism. Starting from a set of 180 plantlets, reproducible monomorphic RAPD banding patterns have been obtained using all the tested primers. Figure 2 illustrated typical examples of DNA profiles produced using the OPE16 (panel a) and OPD05 (panel b).

All the primers screened, were found to amplify a total of approximately 60 bands. The number of bands for each primer varied from 1 to 9, with an average of 5 bands per primer (Table 2). These results indicate the efficiency of the RAPD technique to highlight the diversity of the plantlet DNA; Further, whatever the used primer, the RAPD banding patterns were constant within both all plantlets and the plant mother which unambiguously showed the absence of variation about both the number and the position of the obtained amplified DNA fragments for each one of the tested primer.

Thus we assume that strong genome stability characterizes the in vitro progenies according to the designed experimental conditions. In addition, as reported in figure 3, similar results have been registered in the AFLP banding patterns. In fact the six primer pairs tested for their ability to generate AFLP banding patterns from DNA corresponding to the plant mother together with all the derived in vitro plantlets yielded a total of 200 bands ranged in size from 100 - 600 bp with a mean of 58.33 fragments per primer combination. Figure 3 illutrates typical examples of AFLP banding profiles generated by EACA/MCTA primers' combination.

Analysis of the ALP banding patterns exhibited no variation about the number and the size of AFLP bands either among the progeny profiles or between progeny and the mother plant one. This result strongly supported the genome stability reported above since the used primers combination have been reported as consistent tools to evidence polymorphisms in this crop (Rhouma et al. 2007). Therefore, taking into account the derived banding patterns via RAPD and AFLP analyses, we assume that a genome conformity is observed in the resultant plantlets suggesting that the 2,4-D didn't induce somaclonal variation in date palms. Such result is for great importance for the scaling-up of the designed process aiming at mass clonal micropropagation of date palm. Similar results have been reported in plantlets regenerated from embryogenic suspension cultures in the Tunisian date palm Deglet Nour cv. (Fki et al. 2003). In fact these authors have described the use of flow cytophotometry analysis to examine the ploidy level of the plantlets studied and revealed identical ploidy level in the mother plant and its in vitro progeny. Moreover, among 100 microsatellite alleles, difference about only one allele size has been registered in one plantlet over 150 studied (Zehdi et al. 2004). Similar results have been reported in other crops through

Fig 1:

somatic embryogenesis such as in (Tautorus et al. 1991; Michaux-Ferrière et al. 1992; Heinze and Schmidt 1995; Vasil 1995; Cohen et al. 2004).

One possible explanation to this fact would be related to conservative forms of generating the embryogenic lines, namely, embryo cleavage, as is the case in conifers (Tautorus et al. 1991) or multicellular budding (Michaux-Ferrière et al. 1992). Besides, somatic embryogenesis is claimed to be less prone to genetic alterations because it entails the expression of many different genes (Vasil 1995).

Nevertheless, genetic variation in somatic embryogenesis has been reported in other crops (Rotino et al. 1991; Hawbaker et al. 1993; Ostry et al. 1994; Isabel et al. 1995). On that subject, it is obviously necessary to enlarge both the number of plantlets and/or the number of primers to best cover the genome. Even so, it will be interesting to try other techniques used to detect genomic diversity such as the Random Amplified Microsatellite Polymorphism (RAMPO) and the Single Strand Conformational Polymorphism (SSCP). At the moment, research is currently in progress in order to clear up this problem.

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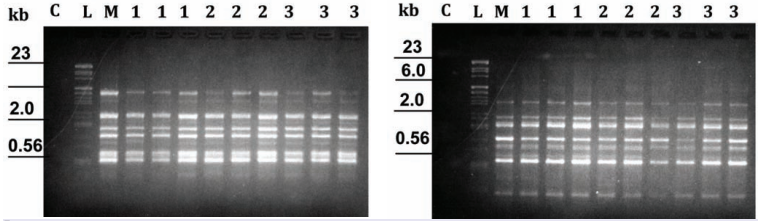

Fig 2

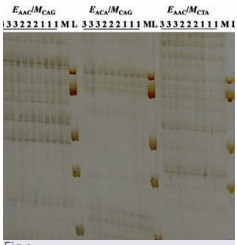

Fig 2

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Table 1: Composition of media used for date palm in vitro regeneration

Meduim composition (mg l-1)	M1	M2	M3	M4
MS salts	4,568	4,568	4,568	4,568
MS vitamins	1	1	1	1
Fe-EDTA	65	65	65	65
Sucrose	50,000	50,000	50,000	50,000
Myo-inositol	100	100	100	100
Glycine	2	2	2	2
Glutamine	100	100	100	100
KH_2PO4	120	120	120	120
Adenine	30	30	30	30
Difco agar	7,000	7,000	7,000	7,000
2,4-D	0	1	10	100
Activated charcoal	300	300	300	300

Table 2: Type of primers used and the number of generated bands.

primer	Sequence	Bands number
OPA-04	AATCGGGCTG	5
OPA-07	GAAACGGGTG	7
OPA-16	AGCCAGCGAA	6
OPC-07	GTCCCGACGA	9
OPD-05	TGAGCGGACA	7
OPA-06	ACCTGAACGG	5
OPA-16	AGGGCGTAAG	6
OPA-19	CTGGGGACTT	9
OPE-16	GGTGACTGTT	6
Total		60

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Fig 1: Induction of somatic embryogenesis and plant regeneration from leaf explants of date palm cv. Deglet Nour. (a) Embryogenic callus within proembryogenic globular structures obtained after 6-month culture period on MS medium including 1 mg.l-1 2,4-D (M2). (b) Direct embryogenesis at the basic part of a juvenile leaf cultured on MS medium including 1 mg.l-1 2,4-D for 6 months of culture. (c) Initiation of differentiation of embryogenic callus after 1 month of transfer on MS medium supplemented with 0.1 mg.l-1 2,4-D. (d) Matured somatic embryos obtained after 10 weeks of transfer of differentiated embryogenic callus on MS medium deprived of 2,4-D. (e) Hardened-plantlets with full radicle and shoot obtained after 3 months of transfer to ½ MS liquid medium supplemented with 1mg.l-1 IBA. (f) Potted plantlets 3 month after transfer to a green house. (f) two years plants old after transfer to free-living conditions. (g). Scale bar: (a)10 mm; (b) 5 mm; (c)10 mm; (d) 20 mm; (e) 15 mm; (f) 100 mm; (g) 300 mm

Fig 2: RAPD DNA banding profiles generated using OPE16 primer (panel a) and OPD05 primer (panel b). Negative control (C); Molecular size marker (L); Mother plant (M); plantlets from media including 1, 10, 100 mg.l-1 2,4-D respectively (lanes 1, 2, 3)

Fig 3: Typical examples of AFLP banding profiles generated by EACA/MCTA primers' combination. Standard molecular size marker (L); Mother plant (M); plants from media including 1, 10, 100 mg.l-1 2,4-D (lanes 1, 2, 3 respectively). ENNN/MNNN, primer pairs, E and M for EcoR1 and Mse1 restriction enzymes respectively

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Increasing yield and fruit quality of date palm 'Sayer' with application of nitrogen, phosphorus and potassium optimum levels

Abstract

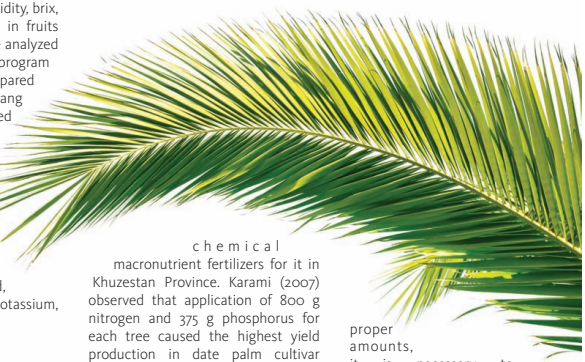
Date palm, Phoenix dactylifera, is one of the most important horticultural crops in Khuzestan Province. Among the date palm cultivars in province date palm 'Sayer' is one of the most commercial cultivars. The low annually average of yield and fruit quality is as a problem for date growers. On the other hand, the most of date growers are not applying chemical fertilizers or applying them in improper amounts. Due to the important of date palm and so the important of minerals element especially nitrogen, phosphorus and potassium in increasing yield and fruit quality, determination of optimum levels of them for date palm fertilization is necessity. In order to increasing yield and fruit quality of 'Sayer' date palm, this experiment with twelve treatments and four replications was carried out in a randomized complete block design on 48 'Sayer' date palm during four years in Khuzestan Province. Treatments were consisted of three levels of nitrogen (N1=700, N2=1000 and N3=1300 grams tree-1), two levels of phosphorus (P1= 500 and P2= 650 grams tree-1) and two levels of potassium (K1=1000 and K2=1300 grams tree-1). Source of nitrogen, phosphorus and potassium were urea, triple super phosphate (TSP) and potassium sulfate respectively. These treatments along with 20 kg of manure and chemical micronutrient fertilizers based on general recommendation applied for each tree in winter by localized placement method (Chalkood). The number of 20-25 leaflets from middle of leaf in second row was picked up, and mineral nutrients of them were determined, each year. At harvesting time, plant parameters such as yield, concentration of mineral elements in leaf, average of weight, length, diameter and volume of fruit fresh, weight of stone and Weight ratio of

fruit pulp to its stone, pH, acidity, brix, reducing sugar, total sugar in fruits were determined. Data were analyzed with MSTATC statistical program and means of data were compared with Duncan's Multiple rang test. The results showed that application of 700g N, 500g P_2O_5 and 1300g K_2O for each tree caused the highest yield and fruit quality. Therefore, annually application of them to date growers is recommended.

Key words: date palm, yield, fruit quality, nitrogen, potassium, phosphorus

Introduction

Khuzestan Province is considered as one of the important regions of date production in Iran. According to agriculture statistic book of Iran, mature date plantation area and production in Khuzestan province are 26000 hectares and 142,000 tons (2003-2004). Among the date palm cultivars in province, date palm 'Sayer' with more than 68 percent of date palm plantation area is one of the most commercial cultivars. Annually average of yield production for it, is reported approximately 60-70 kg for each tree. While there is a higher production potential for this cultivar in this region. Now, Palm-groves of this Province are managed traditionally. In this type of management, proper plant nutrition and soil fertility protection are not completely considered. Therefore determination of optimum levels of fertilizers for this cultivar causes more yield and higher quality of date fruit, so could bring considerable income to farmers and is necessary. This experiment was done in order to study the effects of nitrogen, phosphorus and potassium on yield and fruit quality of 'Sayer' Date palm and determination of optimum levels of chemical macronutrient fertilizers for it in Khuzestan Province. Karami (2007) observed that application of 800 g nitrogen and 375 g phosphorus for each tree caused the highest yield production in date palm cultivar <Mordaseng> in Minab. Shahrokhnia (1992) reported that application of 800 g N and 650 g P_2O_5 per tree was the best fertilizer recommendation for date palm in Jahrom.. Sinclair et al (1981) investigated the effect of different fertilization levels on growth and chemical composition of date palm. They reported that application of 1100 g N and 800 g P_2O_5 for each fruitful tree caused the highest yield and fruit quality. Harhash (2000) recommended 1.5 Kg potassium sulfate/palm/year in date palm. Bamiftah (2000) recommended 2 or 3 Kg of potassium sulfate /palm/year for high yield and fruit quality in date palm 'Zaghloul'. Saleh (2008) showed that using 2.5 kg NPK (named as complete macro fertilizer) along with micronutrient fertilizers caused the highest yield and fruit quality. Dialami (2009) reported that application of proper amounts of nitrogen, phosphorus and potassium caused the best results on yield and fruit quality of date palm in Khuzestan province. Regarding the desirable effects of macronutrients application on yield and fruit quality and this fact that in most palm-groves in this province, fertilizers are not applied in proper amounts, it is necessary to determine the optimum levels and ratios of chemical fertilizers in order to increasing yield and improve fruit quality. Therefore, main aim of this study is determination of optimum levels and ratios of nitrogen, phosphorus and potassium in order to increasing yield and improving fruit quality date palm in cultivar 'Sayer'.



Materials and methods

This experiment was conducted during four years on 48 fruitful, 15 years old date palm in Khuzestan province. Before of application of treatments soil and water were sampled and analyzed (tables 1 and 2). Treatments were consisted of three levels of nitrogen (N1=700, N2=1000 and N3=1300 grams tree-1), two levels of phosphorus (P1= 500 and P2= 650 grams tree-1) and two levels of potassium (K1=1000 and K2=1300 grams tree-1). Treatments were: T1=$N_1P_1K_1$, T2=$N_1P_1K_2$, T3=$N_1P_2K_1$, T4= $N_1P_2K_2$, T5=$N_2P_1K_1$, T6=$N_2P_1K_2$, T7=$N_2P_2K_1$, T8=$N_2P_2K_2$, T9= $N_3P_1K_1$, T10= $N_3P_1K_2$, T11= $N_3P_2K_1$, T12= $N_3P_2K_2$. Source of nitrogen, phosphorus and potassium were urea,

triple super phosphate and potassium sulfate respectively. One second of nitrogen and all of phosphorus and potassium was used in February. Rest of nitrogen was applied in May, each year. These treatments along with 20 kg of manure and chemical micronutrient fertilizers based on general recommendation, consisted of application 150 g of zinc sulfate, iron sulfate, copper sulfate and manganese sulfate were applied for each tree in winter by localized placement method (Chalkood). Agro technical practices such as pollination, thinning, irrigation and so on, were done according to the custom of the region. Each year, in May, the number of 20-25 leaflets from middle of leaf in second row was picked up, and mineral nutrients of them were analyzed. At harvesting time, plant parameter such as yield, average of weight, length, diameter and volume of fresh fruit, weight of stone and Weight ratio of fruit pulp to its stone, pH, acidity, brix, reducing sugar, total sugar in fruits were determined. Data were analyzed with MSTATC statistical program and means of data were compared with Duncan's Multiple rang test.

Results and discussion

The presented data in table 3, 4 and 5 showed that some parameters of fruit quality such as concentration of nitrogen and phosphorus in leaf, diameter, pH, brix and acidity of fruit and stone weight were not affected by treatments. While, the effects of different fertilization treatments on the average yield/palm and fruit quality such as fresh weight, length and volume of fruit, pulp weight and Weight ratio of fruit pulp to its stone as a physical characteristics, total and reducing sugar in fruit and concentration of potassium in date palm leaf as a chemical characteristics was significant.

Yield

The present results indicated that fertilization treatments caused significant increasing in average of production yield in date palm 'Sayer'. Treatment 6, consisted of using 700 g N, 500 g P_2O_5 and 1300 g K_2O for each tree, caused the highest average production yield (111.49 kg tree-1) (table 3). Desirable effects of some macro elements upon date palm yields were reported by other researcher. El-Hammady et al., (1991) found that the highest yield and fruit quality of 'Seewy' dates were obtained by adding 2 kg potassium sulfate/palm yearly. Kassem et al. (1997) reported an increase in N and K contents of pinnate in date palm 'Zaghloul' due to increasing of potassium fertilizer rate, while Ca and Mg contents tended to decrease. Bamiftah (2000) recommended 2 or 3 Kg of potassium sulfate/palm/year for high yield and fruit quality. The present results may be attributed to the physiological role of potassium in enhancing many metabolic processes such as carbohydrate formation, translocation and accumulation (Evans and Sorger, 1966 and Marchner, 1986). Archer (1985) reported that translocation of photosynthetic depended on cell potassium concentration. The obtained results are in close agreement with those found by (Abdalla et al. (1987) ; El-Hammady et al. (1991) ; Shawky et al. (1999) ; Harhash (2000) ; Abdel-Nasser et al.(2000) ; El-Shazly and Abdel-Nasser (2001). In addition to nitrogen, phosphorus is necessary for protein synthesis and energy carriers like ATP (adenosine tri phosphate) (Mengel and Kirkby, 1978), so, using these essential elements could increase the yield. Yield increase with using nitrogen and phosphorus fertilizers in Date-Palm was also reported by by (Karami, 2007; Sabbah, 1993; Bliss and Mathez 1983).

Fruit quality as physical characteristics

Some physical characteristics of fruit such as fruit diameter and stone weight were not affected by treatments. Therefore, the results related to mentioned parameters were omitted. But present results indicated significant increments in fruit quality such as fresh weight, length and volume of fruit, pulp weight and Weight ratio of fruit pulp to its stone as a result of fertilization with different levels of nitrogen, phosphorus and potassium. The results showed that fertilization treatments caused significant increasing in average fresh weight in date palm 'Sayer'. The highest average fresh weight of fruit (7.31 g) achieved by treatment 6, in comparison with other treatments (table 3). There were significant differences among treatments on pulp weight of fruit and higher pulp weight seen at treatment 6. Increment in pulp weight of fruit could be due to improving cell size or cell number by nutrient elements. These finding are in harmony with Sourour et al. (1998). They found pulp weight of date fruit in 'Samany'

cultivar had significant increasing by using organic plus inorganic fertilizers as comparison with organic alone. Dialami and pezhman (2005) reported foliar application of pure Potassium sulfate (5kg/1000L) caused increase yield and fruit quantity characteristics such as weight, length, diameter and volume of fresh fruit, weight, length, diameter and volume of stone and pulp to stone ratio of date fruit in 'Toory' cultivar. Fisher et al. (1959) mentions that Potassium is essential for fruit enlargement. In this experiment application of different levels of nitrogen, phosphorus and potassium caused significant increasing in fruit length. The highest amount of fruit length (4.26 cm) observed by applying of treatment 6 in comparison with other treatments (table 3).Weight ratio of fruit pulp to its stone was affected by using different fertilization treatments. The present results showed that treatments 2 and 6 caused the highest Weight ratio of fruit pulp to its stone (9.68 and 9.74) respectively. Similar results were obtained by (El- Deeb et al., 2000; Ismail, 1999) on 'Hayany' date palm cultivar. They reported that artificial nitrogen fertilizer significantly increases weight ratio of fruit pulp to its stone in fruit date. The fruit volume was affected by fertilization treatments. The highest amount of fruit volume (8.19 cm3) observed by applying of treatment 6 in comparison with other treatments (table 3). Overall, improvement occurred in the physical characteristics could be attributed to effects of nutrients on carbohydrate influx or plant growth regulators synthesis in growing fruits. Potassium plays an important role in, pH stabilization, osmoregulation, enzyme activation, protein synthesis, stomata movement, photosynthesis, and cell extension (Läuchli and Pfluger, 1978). Moreover, potassium is an important solute in expanding cells (Marchner, 1986). These results are in agreement with those obtained by El-Hammady et al. (1991). Kein and zaid (2005) mention that Phosphorus plays a role in processes such as photosynthesis, respiration, vegetative growth, reproduction and maintenance of the genetic identity. It is also associated with cell division, root development and flowering.

Fruit quality as chemical characteristics

Some chemical characteristics of fruit such as pH, brix and acidity of fruit were not affected by treatments. Therefore, the results related to mentioned parameters were omitted. But results indicated significant increments in fruit quality such as reducing sugar and total sugar in fruits as a result of fertilization with different levels of nitrogen, phosphorus and potassium. Application of different levels of nitrogen, phosphorus and potassium enhanced the amount of reducing sugar in date fruit in date palm 'Sayer'(table 4). Increasing in reducing sugar content could be due to necessity of mineral element for synthesis of sugar products and photosynthesis (Broschat, 1999; Mengalel and Kirkby, 1978). Other researcher (Bliss and Mathez, 1983; Sinclair et al., 1981) showed the desirable effect of different levels of nitrogen, phosphorus and potassium on increasing reducing sugar. The obtained results in this experiment, agreement with that found by Saleh (2009) on 'piarom' date palm. Total sugar percentage of date fruit, cultivar 'Sayer' increased significantly by application fertilization treatments. These results are due to the fact that potassium activates the enzymes involving in sugar biosynthesis and helps in translocation of sugars (Evans and Sorger, 1966; Archer, 1985). In addition, Suelter (1970) mentioned that there are more than 50 enzymes which are stimulated by potassium. The obtained results appeared to be in close agreement with the findings reported by Rizk (1987) on date palm 'Samany' and date palm 'Hayany'; El-Hammady et al (1987) on date palm 'Sweey ' ; El- Deeb et al (2000) on date palm 'Hayany'.

Mineral element concentration in date palm leaf

The results showed there were no significant difference between fertilization treatments in effect on nitrogen concentration in date palm leaf but, from the numerical viewpoint, treatment 6 and 1 showed the highest and the lowest nitrogen concentration, respectively (table 5). Also there were no significant difference between the treatments in effect on phosphorus concentration but, from the numerical viewpoint, treatment 10 caused the highest phosphorus concentration in

date palm leaf (780 mg kg-1dry wt.) and treatments 1 and 5 showed the lowest phosphorus concentration (490 mg kg-1dry wt.), respectively (table 5). According to table 5, application chemical fertilizers created significant changes in the potassium concentration in date palm leaf. The present results showed that treatments 2 and 6 caused the highest potassium concentration in the leaf of date palm (5808 and 6746 mg kg-1dry wt.) and treatment 1 showed the lowest potassium concentration (4550 mg kg-1dry wt.) respectively. Increasing leaf elemental contents due to fertilization may be attributed to the fact that using chemical fertilization can improve plant ability to uptake mineral nutrients. Improving plant uptake reflects on increasing vegetative growth and consequently improves efficiency for absorption and utilization of nutrients (Mangle and Kirkby, 1978; Abdel-Nasser and El-Shazly, 2001). These results are in harmony with those obtained by (Perica et al., 1994 ; Loupassaki et al.,1997). In general, it can be found that balanced application of nutrient elements such as nitrogen, phosphorus and potassium is required for optimum nutrition of date palm. Findings of this research showed that application of optimum nutrition of these essential elements had considerable effects on more yield production and improving of fruit quality in date palm 'Sayer'. So, determination of optimum levels of nitrogen, phosphorus and potassium fertilizers and application them for this cultivar is necessity and could bring considerable income to farmers. Therefore, in order to increase of yield and improving fruit quality, annually application of 700 g N, 500 g P_2O_5 and 1300 g K_2O for each tree to date growers in Khuzestan province is recommended.

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Table1. Soil sample analysis of experimental site.

Soil depth (cm)	EC (ds m-1)	pH	OC (%)	Available P (mg kg-1)	Available K
0-30	2.16	7.7	0.83	12	173
30-60	2.74	7.6	0.65	8	155
60-90	2.09	7.7	0.60	8	147

Table2. Water sample analysis of experimental site.

EC (µmhos cm-1)	pH	SAR	Na	Ca	Mg	CO3	HCO3
			(meq L-1)				
2150	7.75	8.32	22.03	6.8	7.2	0	6.25

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Table3. Means comparison of effect of different treatments on yield, fresh weight, length, diameter, pulp weight and volume of fruit, weight of stone and Weight ratio of fruit pulp to its stone

Treatment	Yield (kg tree-1)	Fruit weight (g)	Fruit diameter (cm)	Fruit length (cm)	Fruit volume (cm3)	Fruit pulp weight (g)	Stone weight (g)	Weight ratio of fruit pulp to its stone
T1	85.58b	6.86b	2.06a	3.62b	7.19b	6.68b	0.70a	9.29ab
T2	97.58b	7.02ab	2.05a	3.85b	7.49ab	7.20ab	0.70a	9.68a
T3	87.83b	7.01ab	2.05a	3.76b	6.83b	7.01ab	0.70a	9.28ab
T4	92.09b	7.01ab	2.03a	3.71b	7.11b	7.01ab	0.71a	9.05b
T5	86.17b	6.05ab	2.07a	3.76b	7.23b	6.05ab	0.69a	9.46ab
T6	111.4a	7.31a	2.11a	4.26a	8.19a	6.31a	0.71a	9.74a
T7	88.33b	6.05ab	2.07a	3.78b	7.48b	6.05ab	0.72a	9.35ab
T8	92.58b	6.9ab	2.03a	3.78b	7.02b	6.99ab	0.70a	9.24ab
T9	90.42b	7.12ab	2.04a	3.76b	6.94b	7.12ab	0.66a	9.52ab
T10	89.17b	6.99ab	2.05a	3.76b	7.30ab	6.99ab	0.70a	9.22ab
T11	88.5b	7.06ab	2.05a	3.72b	7.29ab	7.06ab	0.71a	9.38ab
T12	88.7b	7.11ab	1.99a	3.68b	7.19b	7.11ab	0.70a	9.37ab

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Table4. Means comparison of effect of different treatments on pH, acidity, brix, reducing sugar and total sugar in fruit.

Treatment	Fruit pH	Fruit acidity (%)	Fruit brix (%)	Reducing sugar of fruit (%)	Total sugar of fruit (%)
T1	6.00a	0.25a	77.88a	75.08a	66.86b
T2	6.04a	0.27a	78.79a	64.64b	72.78a
T3	6.00a	0.25a	76.54a	65.07b	65.73b
T4	5.59a	0.26a	77.45a	64.64b	67.03b
T5	6.01a	0.24a	76.78a	64.64b	65.84b
T6	6.11a	0.27a	78.05a	69.71ab	69.32b
T7	6.02a	0.26a	76.88a	65.07b	65.95b
T8	6.02a	0.25a	78.04a	61.00b	67.61b
T9	6.00a	0.25a	76.66a	65.85b	67.17b
T10	6.05a	0.25a	77.38a	67.08b	66.02b
T11	6.02a	0.26a	77.46a	67.08b	64.64b
T12	6.11a	0.24a	77.96 a	69.70ab	67.63b

Tables. Means comparison of effect of different treatments on concentration of nitrogen, phosphorus and potassium in leaf.

Treatment	Nitrogen (mg kg-1 dry wt.)	Phosphorus (mg kg-1 dry wt.)	Potassium (mg kg-1 dry wt.)
T1	8270a	490a	4550b
T2	8823a	522a	5808a
T3	8274a	509a	4695b
T4	8272a	499a	5126b
T5	8420a	490a	4918b
T6	9291a	521a	6746a
T7	8672a	498a	4972b
T8	8239a	492a	4800b
T9	8700a	500a	5000b
T10	8547a	780a	5000b
T11	8376a	490a	4729b
T12	8329a	492a	4671b

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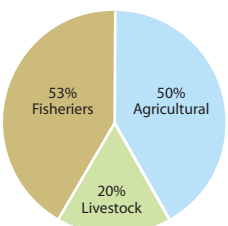
Agriculture and Fisheries Development Fund (AFDF) of Oman ... contribute to the development of date palm

Historically there is a strong relation between most Omani citizens and date palm that always get an opportunity to be improved and become stronger. Sultanate of Oman is giving an important attention to the tree built on comprehensive national strategy related to applied scientific research, extension, and investment towards sustainable development. For the last five years Agriculture and Fisheries Development Fund (AFDF) funded many development projects that have technical and socio-economic valuable achievements. New projects are coming to be implemented. This article focuses on the establishment, activities of AFDF, and its role in developing date palm.

Establishment of AFDF

Establishment of AFDF was under Royal Decree No. 48/2004 issued on 15/05/2004. It represents a highest recognition to the constructive role of agriculture, livestock, and fisheries sectors to the national economy.



Objectives of the Fund:

The main objectives of AFDF include: (i) Conducting scientific researches that contribute to the sustainability

Figure 1 Distribution of projects Funded by AFDF, Oman

of agriculture, livestock, and fisheries sectors (ii) Developing and creating new techniques for best production practices (iii) Implementing extension projects and programs (iv) Promoting development studies and programs in addition to the economic feasibility studies for the developmental projects (v) Development of human resources through training, upgrading skills, and improve efficiency of staff and beneficiaries in various research and development areas.

Funding areas: AFDF contributes to the following areas:

Conducting studies and surveys for the assessment and use of the agricultural, livestock, and fisheries resources and the provision of the required basic information and data for the sector's development plans.

Contribution to the preparation of technical and economical feasibility studies for marketing of agricultural, animal, and fisheries products.

Promotion of agricultural, livestock and fisheries extension projects for enhancing productivity in terms of quantity and quality as well as the judicious use of natural resources.

Upgrading technical efficiency of the farmers, livestock growers, and fishermen. Also the transfer of suitable modern technologies which are capable of improving the economic returns.

Qualification and development of the human capabilities especially for farmers, livestock growers, and fishermen.

Agricultural, livestock, and fisheries pests and diseases control. Also those related to or joint with human.

Contribution to the projects pertaining to the infrastructure and services of the sectors and their related marketing activities.

Conservation of plant, animal and fisheries genetic resources as well as the means of their promotion.

Modern techniques such as irrigation systems' subsidy and related aspects.

Any other areas decided by the Board of Directors in accordance with the stipulated objectives in the Decree of establishment.

AFDF Total Activities:

AFDF is funding many development, research, extension and rehabilitation projects that aim to serve the agricultural, livestock, and fisheries sectors. As shown in table (1). AFDF had accomplished 57 projects which cost about OR 10 million (equivalent to about US$ 26 million). There are 56 ongoing projects which cost more than OR 10 million (equivalent to about US$ 26.5 million).The outcomes of these projects served the three sectors in many important aspects.

In agriculture they aimed to integrated pests management (IPM) on date palm and fruit trees, resources management, develop water management methods and applying modern irrigation systems, improve and maintain mango trees, green houses, house gardens, and many other important subjects. Also covered genetic engineering, seed production and improvement in agricultural productivity of many crops such as onion, sugar cane, Omani garlic, potato, wheat, date palm and fruit trees namely mango, Omani lime, and pomegranate. The projects also address other relevant issues such as improvement and reproduction of honey bees, plant genetic resources, olive oil extraction and economic evaluation of the projects funded by AFDF and Ministry of Agriculture (MoA). These projects have also led to the introduction of new technologies, modern agricultural practices and mechanization techniques introduced to the beneficiaries.

In respect of livestock, the projects concerned with the issues of control diseases, reproduction and improvement in productivity of local breeds of livestock, extension programs

Table (1) AFDF funded projects and their costs, since establishment until October, 2010

Sector	Cost of Projects								
	Finished			Continues			Total		
	No	Om R	US $	No	Om R	US $	No	Om R	US $
Agriculture	20	3,113,570	8095282	30	4,627,767	12032194	50	7,741,337	20127467
Livestock	8	695,581	1808510	12	1,319,066	3429571	20	2,014,647	5238082
Fisheries	29	6,141,758	15968571	24	4,232,993	11005782	53	10,374751	26974352
Total	57	9,950,909	25872363	56	10,179,766	26,467,537	123	20,130735	52,339,911

and development of the traditional systems of breeding, production, management of goats, sheep, cattle, and camels and establishment of model village for breeders. They cover Ostrich, poultry, dairy production and monitoring of rangelands. There was a project related to institutional capacity building as a part of technical cooperation with FAO on monitoring and evaluation of rangelands in Dhofar Governorate.

Breeding of local poultry, improving productivity of small ruminants (goat and sheep), mapping of epidemic and transmitted diseases and control of external and, animal genetic resources such as Genetic Characterization of Local Goats and Sheep Breeds by using fingerprinting, and internal parasites are other issues of interest.

In fisheries sector, the projects aim to study biology of various fish species, locations and movement of fish stocks, supporting fishery units, improve practical skills of researchers, fishermen, and other beneficiaries, developing methods of legislations implementation, increase efficiency of resources management, marketing, communication systems, discover fishing grounds, and many other important applied topics.

Some of these projects, with a significant portion of the finance, have been directed to capacity building of researchers, farmers, breeders, fishermen. Other family members made use of many outcomes, such as rural women, youth, and other beneficiaries across the Sultanate. AFDF activities covered most Wilayats of the Sultanate.

In summary, AFDF financed total of 123 projects coasted more than OR 20.1 million (equivalent to more than US$ 52.3 million) has accomplished many achievements via implementing several developmental, research, extension and rehabilitation activities.

Distribution of date palm in Oman:

Date palm is considered as the first crop in the Sultanate of Oman in terms of number and distribution. Extra attentions have been given to the tree from the farmers and governmental agencies. The religious and social deep-rooted heritage enhanced its economic, nutrition and

Pictures of some date palm projects funded by AFDF, Oman... Cold Storage research

environmental benefits.

Sultanate of Oman has about 8 million date palms (6.5 million trees productive female) produce average of about 254 thousand tons of date during 2004-2008. Year 2008 production grew by 36000 tons (13%) more than 2004. AlBatinah Region is the biggest in number of trees and production; about 2.8 million trees (43% of total) produce about 111 thousand tons, 44% of total. AlSharqiya area came second in number of trees, about 1.4 million (21% of total) and third in production, 43 thousand tons (17%), while AlDakhliyah came second in production, 50 thousand tons (20%) and third in number of trees, about 952 thousands (14% of total). Date palm covered about 50% of total agriculture land; represent 83% of fruit trees land in the Sultanate. Oman has more than 250 species of date, some of good quality, commercial value, maturing date, nature of consumption and usage, diseases' resistance, and yield. Some species are better than many well-known internationally; each area has its own best species. These indicators need to be considered for any development programs or new future expansions.

Role of AFDF in developing date palm:

Agriculture & Fisheries Development Fund (AFDF) was supporting the efforts of maintaining and developing the blessed tree for the last 5 years and efforts are continuous. AFDF financed 21 developmental projects costed more than 3.815 million Omani Riyals (more than 9,919 million U S Dollars).

They deal with research, development, extension, and support programs.

Six main issues were covered:

Pest management and date palm diseases; such as developmental project to control date palm pests (OmmatissusLybciusDeBergevin),four stages, integrated pest management (IPM) of red weevil on date palm, (Rhynchophorus ferrugineus Oliver), four stages

Date palm propagation; such as improving productivity of tissue

Table (2) Projects financed by AFDF to develop date palm directly -Sultanate of Oman

Sq	Cost/OR	Project of direct effect
1	308260	Developmental Project to Control Date Palm Pests ***(Ommatissus Lybcius De Bergevin),*** 1st stage
2	301940	Developmental Project to Control Date Palm Pests, 2nd Stage
3	300000	Developmental Project to Control Date Palm Pests, 3rd Stage
4	301000	Developmental Project to Control Date Palm Pests, 4th Stage
5	100000	Integrated Pest Management (IPM) of Red Weevil on Date Palm, (Rhynchophorus ferrugineus Oliver), 1st Stage
6	262088	Integrated Pest Management (IPM) of Red Weevil on Date Palm, 2nd Stage
7	315220	Integrated Pest Management (IPM) of Red Weevil on Date Palm, 3rd Stage
8	300520	Integrated Pest Management (IPM) of Red Weevil on Date Palm, 4th Stage
9	305581	Improving Productivity of Tissue Culture Lab. (Date Palm)
10	100000	Cold Storage of Rutab) Dates(
11	141460	Finger Print and Genetic map of Date Palm (***Phoenix dactylifera L***)
12	100280	Introducing Modern Irrigation Systems for Date Palm in Wadi Qurayat ,El-Dakhiliyah
13	100000	Construction of Gene Banks for Date Palm ,Mango and Citruses1.st Stage
١٤	120000	Construction of Gene Banks for Date Palm, Mango and Citruses. 2nd Stage
١٥	58000	Evaluation of Agricultural Process Projects and Supporting them to Improve their Competitive in International markets; Stage One Date Palm Process Units and Factories
	3,114,349	Total (US$ 8,097,307)

Table (3) Projects financed by AFDF to develop date palm indirectly-Sultanate of Oman

Sq	Cost/OR	Projects of indirect effect
1	100000	Study the Costs of Agricultural and Animal Production Inputs
2	46300	Sample Survey of House Gardens
3	60000	Economic Evaluation of Projects Funded by AFDF and Developmental Projects been Approved by MOA
4	257500	Improve Irrigation Systems Management for Farmers
5	169000	Management and Registration of Chemicals (pesticides and herbicides)
١	68000	Management of Agricultural Resources
	700,800	Total (US $ 1,822,080)

culture laboratory, for date palm at Jumah, Bahla Willayah,

Maintain local varieties especially those of high quality and market value; such as finger print and genetic map of date palm (Phoenix dactylifera L). Construction of gene banks for date palm, mango and citruses, which contributes to the supporting of the gene bank activities that established 1988. Those projects produce integrated activities related to applied research with the developmental requirements aiming to sustainability.

Improve and develop productivity and quality of date palm: such as introducing modern irrigation systems for date palm in Wadi Quriyat, that contribute to water usage optimization and reduction in water lost. Cold storage of Rutab (dates) project is one of the post harvest improvement techniques to add value to the Omani dates. These projects improve the efficiency of marketing locally and for export. The final goal is to increase profitability of any investment project produce date.

Capacity Building; AFDF financed many projects contain components and activities aim to enhance efficiency at institutional level and\ or human resources level. Date palm growers, farmers, and ranches owners received different kind of training, extension and support programs.

Many researchers, young professionals involved in programs of graduate and postgraduate degrees, PhD, MSc, and BSc in many disciplines from local and

Pictures of some date palm projects funded by AFDF, Oman... Tissue culture lab, Modern irrigation systems, Finger print & gene maps, IPM of Red Weevil on Date Palm

international universities. Training programs, workshops, scientific conferences, field visits, and many other programs helped the beneficiaries to learn new concepts and techniques to improve their work. Other activities devoted towards farmers, animal growers, and fishermen, their families, and local communities. The training covered many needs of AFDF staff as well to speed up process, mechanize procedures, and ease implementation.

Enhance the statistical database; Some projects aimed to build or update the database of date palm with many other crops, survey varieties, distribution, productivity, cost of production and some economic indicators. Programs such as sample survey of house gardens, study the costs of agricultural and animal production inputs, economic evaluation of projects funded by AFDF and developmental projects been approved by MoA ,and management of agricultural resources all aimed to provide updated and accurate data and consequently improve efficiency.

Generally speaking AFDF has funded 14 projects, costed more than OR 3.1 million (equivalent to about US$ 8.1 million) of direct effect on date palm development and another 6 projects, costed OR 700,800 (equivalent to about US$ 1.8 million) of indirect effect, as shown in tables 2 and 3 below.

AFDF had given an important attention and care to quality of implementation and timing, therefore AFDF choose the specialized general directorates of the responsible ministries, Ministry of Agriculture and Ministry of Fishery Wealth, and University of Sultan Qaboos to implement the projects. Highly qualified scientists, researchers, and workers in the fields of extension and development are now doing the job.

The Introduction of these new techniques, modern environment friendly systems, and other development aspects, caused many technical and socio-economic achievements recorded as part of AFDF contributions towards sustainable development. Promising projects based on clear economic indicators and strategic vision are coming to add more value to this heritage towards sustainable development in Oman.

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