The Blessed Tree

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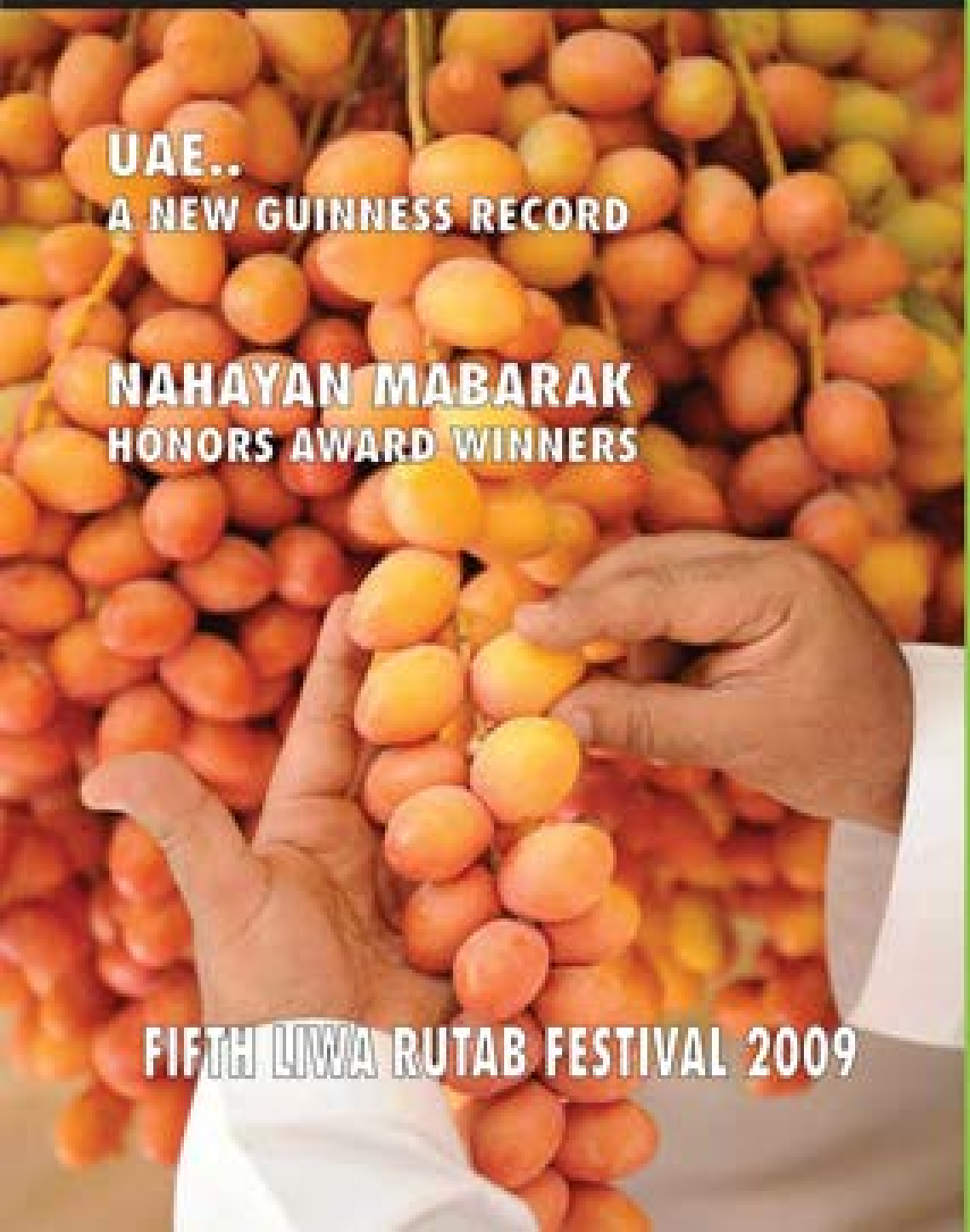

UAE..
A NEW GUINNESS RECORD

NAHAYAN MABARAK
HONORS AWARD WINNERS

FIFTH LIWA RUTAB FESTIVAL 2009

HAMAD KHAMA ALSHAMSSY
Sheikh Zayed, may God bless his soul, and H. H. Sheikh Khalifa, God protects Him, had a great role in improving date palm agriculture all over the country till the UAE become the world's No. 1 in that field.

INTEGRATED PEST MANAGEMENT

MANAGEMENT OF RED PALM WEEVILIN DATE PALM

Photograph by: Nezar Ballout

Photograph by: Jack Jabour

جـائـزة خـلـيـفـة الـدولـيـة لـنـخـيـل الـتـمـر
KHALIFA INTERNATIONAL DATE PALM AWARD

OUR TREE

Following Khalifa Steps

No doubt that nations and countries face numerous challenges along their way of development and growth. Some of these challenges are natural and others are artificial. This is a common feature of life aspects, if not – we can safely say that – this is life itself, where God created us and great men prove they are distinguished by exceeding others in leading their nations and countries armed with their sincere devotion to the land and human being in addition to believing of the nobility of the mission. They show their determination and stamina to face hardships in order to achieve national aspirations within a strategic vision of sustainable development, where spirits rise high with no limits to uphold the country's prestige.

In Khalifa International Date Palm Award we have a vision and a strategic objective and a program of action, besides we have also a beacon that guides us and it is our source of pride where we uphold and stick firmly to the wise vision of HH Sheikh Khalifa bin Zayed Al Nahyan "God Protect Him", President of UAE as a leader, a teacher and a father for all the people of our nation.

We are following his steps on the path of success, achievements and excellence. The major realization achieved by UAE in different areas was not out of contingent or exceptional circumstances. But it was a crowning for striving efforts and the fruit of the integrated development strategy under the wise leadership the country's President "God Protect Him". The country's development strategy endorsed the principle of equality and activating all available resources with no exception, and the most significant that this strategy undertook to keep pace with the evolution and change notion experienced by the global economy with all its challenges.

Accordingly the Award in its first session seems to enter a very competitive and leading field with its counterparts across the world with its record full of achievements for giving and excellence. This is through promoting scientific research related to developing the palm tree and encouraging those involved in propagation & cultivation sector, date palm production and manufacturing, further establishing a constructive cooperation with various parties concerned, individuals, institutions, societies, companies and bodies relevant to the blessed tree. Most importantly to spread the culture of interest of the palm tree and localization of the specialized knowledge and encourage innovative initiatives around the world.

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

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OUR MESSAGE

A Well-Deserved Success

For the people of the UAE, a palm tree is a symbol of goodness and giving. They look at it as the secret of their survival and one of the factors of their adherence and loyalty to this land, since it's the palm tree that provided them with food, health and a source of income. From palm trees they acquired all the requirements of their lives such as the tools they used at home, at the farm, at the market and when fishing. That is why a palm tree is justly called a Blessed Tree. The late Sheikh Zayed Bin Sultan Al Nahayan – May God bless his soul – used to encourage taking care of palm trees and growing more of them. This highly esteemed invitation was answered by a wide response from the UAE sons and the number of palm trees in the country reached more than 40,700,000 according to the latest surveys of the Ministry of Environment & Water in 2005 (Ministry of Agriculture and Fisheries, previously)

Consequently, the UAE made a record for the biggest number of date palm trees in the world in 2009 according to Guinness Book of Records which presented the first certificate for the first record of its kind in the world. This appreciation was due to the wise vision of the first Man of the Environment, the late Sheikh Zayed bin Sultan Al Nahyan – May God bless his soul –, and thanks to the wise directives and the continuous unlimited support of the Palm Tree sponsor, H.H. the President Sheikh Khalifa Bin Zayed Al Nahayan – May God protects him, who provided a positive work environment where innovation and excellence can flourish.

Furthermore, the efforts of H.E. Sheikh Nahayan Mabarak Al Nahayan, Minister of Higher Education and Scientific Research / Chairman of Khalifa International Date Palm Award Board of Trustees, had a great effect on developing date palm sector in the UAE, through the sponsorship of the UAE University for date palm compound in Al Ain which includes the biggest scientific, research and production institutions to serve this blessed tree. Such institutions include the international date palm network, the Arab Center for Genetic Engineering and Biotechnologies, Date Palm Friends Society and Date Palm Research & Development Program, in addition to the recently launched Khalifa International Date Palm Award.

Our congratulations to the UAE for making the first record of its kind in growing date palm trees in the world. We also extend our congratulation to the leadership, the government and the people of the UAE, as well as the Ministry of Environment & Water, Department of Municipalities & Agriculture / Agriculture sector, the institutions, societies, authorities, individuals, farmers, producers, manufacturers, researchers, specialists and every one who loves this blessed tree on this benevolent land.

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

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KHALIFA INTERNATIONAL DATE PALM AWARD

The Blessed Tree

A seasonal scientific magazine specialized in date palms

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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.

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"With efforts and wisdom of Khalifa Bin Zayed, UAE holds the first place worldwide in Date Palm cultivation", Nahayan Mabarak

Nahayan Mabarak honors Award winners in its first session

HH Sheikh Nahayan Mabarak Al Nahayan Minister of Higher Education and Scientific Research, President of Board of Trustees of Khalifa International Date Palm Award stressed to continue in serving the comprehensive agricultural development and the blessed tree in words and in practice under the wise leadership of HH Sheikh Khalifa Bin Zayed Al Nahayan, President of the UAE "God protects him" in order to achieve food security, sustainable development, love and peace for society and human kind all over the world.

This came during HH speech at the Award ceremony of Khalifa International Date Palm Award in its first session yesterday morning at Emirates Palace in the capital Abu Dhabi. The ceremony was organized by the General Secretariat of the Award and was attended by a number of international organizations, members of diplomatic corps and a large number of researchers and stakeholders involved in the Date Palm and members of the scientific committee and the winners of the Award in its first session for 2009.

HH stressed that growing Date Palm in the UAE is a basic corner of the comprehensive development process with its role to build and upgrade the agricultural production capacities and revival relevant industries. Studies and researches confirmed that development in agriculture did not come from nothing but it aimed to achieve a strategic dimension with a clear view when it comes to food security. HH Sheikh Khalifa Bin

Zayed Al Nahayan, President of the UAE "God protects him" and from the onset of the march what the agricultural development signifies as a real capital, therefore he took the initiative to provide all aspects of support to enhance, develop and increase the cultivated areas and achieve self-sufficiency and diversification of income. It is also evident that the agricultural policy occupied a great deal in the heart of HH the President of the country and reflected the special attention attached to the blessed tree in continuation to the approach of the late Sheikh Zayed Bin Sultan Al Nahayan "may God rest his soul in peace" in paying attention and meeting the requirements of the unique agricultural experiment in the land of our homeland.

"UAE enjoys a very prestigious position at the regional and international levels due to the unique model and the pioneering experience

that is witnessed by the huge achievements and outcomes in providing all capabilities to protect the natural resources and implementing projects and ambitious plans to desert reclamation and forests planting which is seen a real miracle by all international standards in planning and implementation. This why it was logically that the deliberated agricultural planning and implementation have led to self-sufficiency and even exporting the surplus as well", HH added.

The civilized scene of our country today stands in glory and splendor within a special bilateral framework to combine the UAE human with his good land in one system that emphasize the insight realization of our wise leadership to the difference between accumulation of wealth and making the development.

"As we are celebrating today to honor those who win the Award in its first session 2009, we would like to confirm in the name of the Board of Trustees and those honored and scientific and organizing committee to move forward in serving the comprehensive agricultural development and the blessed tree in thought and practice under the wise leadership of HH Sheikh Khalifa Bin Zayed Al Nahayan, President of the UAE "God protects him" so as to provide food security and sustainable development, love, peace for the society and human all over the universe. The Award is a message from a national prospect but global in its framework for benefit and peace of all mankind", HH reiterated.

"The green hands of Zayed (may God rest his soul in peace) have planted millions of Date Palm trees all over the country", Prof. Looney said.

HH President of Board of Trustees of the Khalifa International Date Palm Award expressed his thanks and appreciation for the winners of the different categories of the Award in its first session for the distinguished efforts in promoting and developing the scientific researches and studies, distinguished producers and distinguished individual figures that have contributed significantly and effectively. We really value all these efforts done to be a good start to help developing and progressing of all human communities to achieve the objectives which the Award was established for.

On the other hand HH Sheikh Nahayan pointed out that the strategic planning of the agricultural development in the UAE and Date Palm in particular which was pursued by the late Sheikh Zayed Bin Sultan Al Nahayan for more than half a century and followed by HH Sheikh Khalifa Bin Zayed Al Nahayan, President of the UAE "God protects him" has led to the doubling of planted areas of Date Palm and achieve qualitative jumps in fighting the phenomenon of desertification, expanding the planting cover and spread of food industries based on Dates and others. UAE became the first country worldwide in the number of Date Palm trees according to Guinness World Records.

HH added that in this instance we like to present this international record to the soul of late Sheikh Zayed Bin Sultan Al Nahayan "my God rest his soul in peace" and to HH Sheikh Khalifa Bin Zayed Al Nahayan, President of the UAE "God protects him" and to HH Sheikh Mohamed Bin Rashid Al Maktoum, Vice-President, Prime Minister and Ruler of Dubai and to HH Sheikh Mohamed Bin Zayed Al Nahayan, Crown Prince of Abu Dhabi, Deputy Supreme Commander of the UAE Forces for their efforts and limitless support for the blessed tree and the proud people of the UAE

as promise and commitment to guide us in the march of sustainable development for the UAE community.

HH President of Board of Trustees also called on the respectful scientists, specialists and those involved in the Date Palm all over the world to contribute to the Award magazine "The Blessed Tree" that we aspire to enrich and benefit the national development of knowledge, and scientific research to all employees in the fields of Date Palm from cultivation to production, manufacturing, and marketing according to the international quality and excellence standards and criteria.

On the other hand Prof. Norman Looney CEO of the International Organization of Horticulture Sciences – Canada and chairman of the Award scientific committee called on in his speech during the Award winners distribution ceremony in its first session 2009 that we are in this occasion living in the shade of the Date Palm we have to recall the efforts of the late Sheikh Zayed Bin Sultan Al Nahayan "may God rest his soul in peace", founder of the UAE and guardian of its agricultural renaissance who planted millions of Date Palm all over the country and stressed on the importance of cultivation and agriculture to provide food security and stability of the society. Meanwhile we cannot miss out what we see from increasing development and great interest attached to the blessed tree from cultivation, production and marketing to the Dates all over the world under the wise leadership of HH Sheikh Khalifa Bin Zayed Al Nahayan, President of the UAE "God protects him".

He added addressing HH President of Board of Trustees of the Award "We at the scientific committee of Khalifa International Date Palm Award we greatly value your good efforts in promoting and developing the blessed tree through scientific researches and studies, production and manufacturing of Dates and maximizing the interest of the public and those involved all over the world to be honored to win the Award that is honored by its name with the name of the Date Palm patron HH Sheikh Khalifa Bin Zayed Al Nahayan, President of the UAE "God protects him". We have been keen as a specialist committee to apply the highest international standards in the world in examining, scrutinizing and refereeing files of the applicants to the Award. We provided a very conducive and competitive environment that enjoys transparency and impartiality according to the best professional criteria. Please allow me here on behalf of myself and my colleagues members of the scientific committee to extend our sincere congratulation and best wishes for the Award winners due to their genuine efforts done on their part in serving the Date Palm tree everyone in his own position and commend their leading role in promoting and consolidating the role of the date palm in supporting and stabilizing the food security of the society. This Award came as a suitable event to encourage all involved and interested in the Date Palm all over the world to increase their innovations in order to have the honor to win the Award.

Prof. Norman Looney, Chairman of the Award scientific committee concluded his speech saying that hosting of the Award by the UAE did not come from nothing, therefore UAE will definitely reap its fruit as the Award is a strong entity in the international entities structure. UAE was and still has a leading position with the support of the regional and international efforts in Date Palm cultivation and production due to the economical importance in fighting hunger and poverty in many countries in the world which leads to the security prevailing, stability and peace in the world.

Guinness record is a crowning for efforts of Zayed "may God rest his soul in peace" and Khalifa "God protects him" in serving and developing the Date Palm sector in UAE and the world


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2009

Nahayan Mabarak honors Award winners in its first session

Category II: Best producers in the field of palm trees and dates

First winner: Atol Company / India

India is one of the most important importers of medium-quality types of dates, and non-packed appropriately. With increasing the awareness among consumers, the demand of high quality species increased, so Atol "which is a member in Lalbahai group and the first company established by the first Indian prime-minister handling the agro-industrial solutions", decided to develop palm trees in India and after several studies and researches on date palms and the best climate for its cultivation in India, they found that the desert lands in India next to the Pakistani borders in the north west side is the appropriate environment for the cultivation of several kinds, such as: Alkhadrawi, Almajhoul, Alberhi, Alkhenaizy, Alzamli, Alsaqei and Alkhalas .

Atol has decided to set up a laboratory to grow palm tissue for the production of large quantities of the finest kinds to contribute to the reforestation of desert lands and to meet the domestic demand of such kinds in India.

Second winner: Emirates Bio Fertilizer Factory / UAE.

(For its effective role in developing date palm trees agriculture in UAE and the Arab world)

Emirates Bio Fertilizer Factory was setup in Alain in 1995 as a national leader in recycling animals and plants wastes and manufacturing them in the form of organic fertilizers free of environmental pollutants, pathogens and Nematodes in order to get a clean environment free of contaminants. The factory has obtained several international certificates and awards, such as ISO 9001/2000, and a certificate of IFOAM (International Federation of Organic Agriculture Movements) and the Germany Certificate of (DAR) for organic agriculture. Also the factory has got the membership of the Center for Organic Agriculture in Egypt, in addition to winning Sheikh Khalifa Industry Award 1999 and 2000. The factory played a leading role in improving the performance of agriculture in the UAE in both public and private sectors, through preparing awareness programs on the benefits of organic agriculture and its effect on human and environment as well as holding seminars and the active participation in local and international exhibitions. The factory currently produces 150000 tons of organic fertilizers and 35000 tons of chemically dissolved fertilizers and grained slowly melting and 30000 tons of pelet, also the factory has more than 50 product of fertilizers being exported to more than 11 countries such as Taiwan, Egypt, Syria, Lebanon, Germany and the GCC. And the section which is grinding palm wastes and turning it into organic fertilizers is a great step to be added to the achievements of the factory in the area of palm agriculture in the UAE and the Arab world.

مصنع الإمارات للأسمدة البيولوجية
Emirates Bio Fertilizer Factory

WHO ARE THE WINNERS...

The first session 2009 of Khalifa International Date Palm Award?

Category I: Distinguished researches and studies in the field of date palms and dates.

The first winner:" the prize was withheld"

The second winner: National Institute of Agricultural Research in Morocco

المعهد الوطني للبحث الزراعي
Institut National de la Recherche Agronomique

(For its distinguished efforts in developing date palms sector and especially resisting Bayoud disease)

Since its foundation, the National Institute of Agricultural Research has gained a leading position in developing date palm sector on both Arab and international levels through conducting scientific, technical and economical researches in addition to future studies. The results of these researches were published inside and outside Morocco. Furthermore, the institute established specialized laboratories and prepared a team of specialized and qualified researchers which comprised 193 researchers and 218 technicians in the field of date palm.

Creating new date palm species which give high date's production and high level of disease resistance is considered as one of the most important achievements made by the institute. Moreover, the institute has prepared researches to classify different date palm species using traditional and recent methods like , for example, molecule footprints techniques and Deoxyribonucleic Analysis (DNA) The institute also developed techniques for early detection of Bayoud disease and identification of genetic diversity of fungus that causes it, in addition to creating effective ways to resist it including physical, biological and chemical methods. The most innovative means to control the disease is discovering resistant species of date palm and increasing these species using Tissue Culture technique.

Also, the bank of genetic resources of natural and hybrid types of date palm is one of the most important achievements of the Institute.

The Board of Trustees held its second ordinary meeting headed by Nahayan Mabarak Al Nahayan

Board of Trustees of Khalifa International Date Palm Award endorses addition of new categories to expand the national and international participation

HH Sheikh Nahayan Mabarak Al Nahayan, Minister of Higher Education and Scientific Research, President of Board of Trustees of Khalifa International Date Palm Award commended the generous sponsorship and strong support rendered to the Award from HH Sheikh Khalifa Bin Zayed Al Nahayan, President of UAE, "God protects him". HH Sheikh Nahayan said we wouldn't have achieved this high standard in serving and developing the Date Palm sector at the national, regional and international levels without this support as acknowledged by specialized bodies and organizations across the world. HH expressed his gratitude and appreciation for HH the President "God protects him" in promise and commitment to place the name of the UAE up high in the field of Date Palm from cultivation, production and development.

This came during HH Sheikh Nahayan chaired the second ordinary meeting of the Board of Trustees of the Award yesterday morning. The meeting was plenary where all members were informed about HH directives concerning addition new categories to the Award that can cover the broadest section relevant to Date Palm and giving the opportunity for more potential participation from specialists and those involved in the blessed tree all over the world. His Highness expressed his happiness with the great success achieved by the Award and high percentage of the participants of the Award in its first session, where the members of the Board of the Award endorsed the addition of two new categories namely the best advising program in Date Palm field and the best social developing project in Date Palm field. General Secretariat will undertake setting up the standards, criteria and technical terms for applying to each of these categories.

Member of the Board also inspected the financial, administrative, technical, and media reports of the Award at its first session and they commended the size of achievement accomplished by the Award General Secretariat achievements during the first year. In view of the fact that the Award reflected a significant presence nationally, regionally and internationally through participation in all activities relevant to Date Palm which enhance the leading role played by the UAE in Date Palm sector due to the wise leadership of HH Sheikh Khalifa Bin Zayed Al Nahayan, President of the UAE "God protects him" and the support HH Sheikh Mohamed Bin Zayed Al Nahayan, Crown Prince of Abu Dhabi, Deputy Supreme Commander of the UAE Armed Forces.

Category III:

The effective person in the field of dates and date palms Mr/Rakan Maktoum Bin Haroun Al Qubaisi/UAE

(For his distinguished role in developing the annual dates festival)

Since 1997, Mr/Rakan Maktoum Bin Haroun Al Qubaisi, Chairman of the organizing Committee of Dates Festival, worked within the framework of a unified team to create a new idea to urge farmers and citizens to give more care to date palms and to increase the quality and the quantity of their production, while showing the date palm as a part of UAE national identity and enhancing the products which depend mainly on dates. Thus, an annual competition was organized to select the best types of dates under the title (Dates Competition). Following the huge success of this competition, the organizing committee decided to develop the event and make it a huge festival, turning it from a competition which includes a limited number of farmers into an annual festival including over 8000 farmers in 2008. Hence, (Liwa Dates Festival) was organized thanks to the directives of His Highness Sheikh Mansour Bin Zayed Al Nahyan, Minister of Presidential Affairs, and the support of His Highness Sheikh Mohamed Bin Zayed Al Nahyan, Deputy Supreme Commander of the UAE Armed Forces and Chairman of Abu Dhabi Executive Council.

Some of the most important objectives of the Festival were enhancing Abu Dhabi's leading role in the development of date palm plantations, encouraging farmers to achieve excellence while taking care of date palms and dates, spreading awareness about the importance of date palms, and honoring the people working in the field of date palms in order to improve and increase production.

the best date palm species, and worked on improving and increasing the species which are planted in the UAE. He used all available efforts to serve the blessed tree, following the steps of the late Sheikh Zayed bin Sultan Al Nahyan "may Allah bless his soul" in giving much care and attention to increasing and developing the date palm tree and by encouraging the nationals to do the same. Hence, all date palms in the UAE today owe their existence and development to the efforts and care of the late Sheikh Zayed.

He is, with no titles, Jomaa AL Majed, the patriot man of development and construction who belongs to the first generation of goodness and giving, the generation of Sheikh Zayed and Sheikh Rashed, may Allah bless their souls. He held and still holds the highest positions and the greatest responsibilities. He was awarded the highest and most prestigious certificates, awards and decorations on the local, Arab and international levels.

H.E. HAMAD RAHMA AL SHAMSY

He established his first date palm farm in ALThaid/Sharjah in 1984. The farm includes about 2000 date palm trees which give an average of nearly 200 tons per year, which means 60-150 kg per each tree according to type and age. All the blessed production is distributed for charity purposes.

The farm contains the best date types such as, Khlas, Berhi, Zamli, Khneizi, Soltana, Nabtit Seif, Helali, Maktoumi and others.

He inherited from his fathers and their fathers a close relationship with the date palm and is continuously looking for all that is new and useful to serve the blessed date palm tree. He continues his search for excellent date types all over the world to bring it to the UAE in order to increase production. His farm in AL Thaid is a role model for agricultural activities in the region, in terms of selecting the best species, technical services, irrigation methods, fertilizers etc….

Thus, it became a role model and a destination for every one who loves the blessed tree.

HE Sultan Khalifa Al Habtour

He likes agriculture and is a friend and a passionate lover of date palm trees who earnestly works on developing its types. Also, he is Vice Chairman of Date Palm Friends Society. He loved the date palm and dedicated himself to protect, develop and spread it until it occupies the eminent position it deserves.

Sultan Khalifa Al Habtour says: we are lucky

Who are the honored persons?

In the field of dates and date palm trees The first season 2009

H.E. JOMAA ALMAJED

When a date palm tree is mentioned, his heart flies with joy, because of his passionate love to this tree which is blessed by Allah and mentioned various times in the Holy Quran. Since childhood, he used to go with his father to their own date palm farm especially in the heat season. In the past, a date palm was a source of income to the family as they used to sell the dates produced by the farm date palms.

He established many farms that included

On the occasion of launch of the first issue of "The Blessed Tree" Magazine

"It is pay-back time to the Date Palm tree", Nahayan Mabarak Under the wise leadership of His Highness the President

The magazine will be launched from Abu Dhabi with a message of love, knowledge, peace and respect to the whole world

HH Sheikh Nahayan Mabarak Al Nahayan, Minister of Higher Education and Scientific Research, President of Board of Trustees of the Award, said in his opening speech of the first issue of (The Blessed Tree) magazine issued by the General Secretariat of Khalifa International Date Palm Award, which has been launched the day before yesterday in his residence on the occasion of Award distribution ceremony in its first session 2009.

His Highness being the magazine Honorary President expressed the profound relationship between the UAE people and the blessed tree along history. The Date Palm was and still the symbol of pride for the UAE people with its height and loftiness. It represented the symbol of life and renewed ample giving. Fathers and grandfathers strived to make UAE a green pastures full of Date Palm orchards that carry ripe date clusters. Many Emirati households worked in farming from a long time and generation after generation they inherited this work. They were keen to reclaim the land and prepare it. Date Palm was at the center of their attention in this field and they were keen to grow and cultivate the Date Palm in orchards all over the country. Since Date Palm through its long history is still the truthful companion for the human being and the safe sanctuary that provided him with food and shelter to face the harshness of living through the journey of life.

His Highness added, "and now doesn't this tree need us to give it all care and workmanship using all available modern means in a world that became a small village where we communicate with all people all over the world with ease?" we can safely say that UAE was a pioneer in providing every care, support and follow up capabilities for more than half a century when late Sheikh Zayed Bin Sultan Al Nahayan "may God rest his soul in peace" was the representative of governor in the Eastern Region in the country. His first developmental initiatives was to secure fresh water for human being and the agricultural land especially the Date Palm oases through digging new water streams and repairing the old ones. The Date Palm got the lion share of the vision of Zayed "may God rest his soul in peace" through the march of development and building the country.

Khalifa International Date Palm Award came to top this vision and the prompt efforts done by His Highness President of the UAE in appreciation to the blessed tree and those involved in this sector whether in UAE or in any other country in the world. This is in order to consolidate the prestigious position and the pioneering role of the country at the Arabian level and International level in the Date Palm field.

to have this palm in our country as it is a gift from Allah the Almighty and it represents our ultimate ambition and demand of achieving food security for the UAE and its people. He took interest in the palm since the seventies of the last century when, in the days of the late Sheikh Zayed, the locals' attention and care for the date palm increased and was supported by science and industry. He has a farm in Ras Al khaimah that includes the best species such as Nawder, Sultana, Majhoul, Sukkary, Berhy, Zamli and other premium types.

As for his recognition, he says that it is a great honor, and at the same time a great responsibility towards the date palm tree to help in the development and prosperity of this blessed tree on the land of Zayed.

Date Palm Friends Society:

Date Palm Friends Society was established in October 25th, 2003 upon Resolution no. 165 issued by the Ministry of Labor and Social Affairs, and is under the chairmanship of His Highness Sheikh Nahyan Mubarak Al Nahyan , Minister of Higher Education and Scientific Research.

The Society aims at collecting, studying and publishing information related to date palm agriculture in the UAE in addition to identifying the main problems and obstacles which encounter the date palm in the country, suggesting the proper solutions in cooperation with the concerned entities, and providing suggestions to increase and develop date palm agriculture in the UAE. Moreover, the Society cooperates with science and research authorities in the country to raise the level of researches in the field of growing and increasing date palms as well as fighting its diseases. The Society also works on exchanging and publishing technical and technological information between research entities and the UAE nationals. In addition, the society also issues brochures, magazines and books and organizes exhibitions & seminars on date palm agriculture to promote for its products in the country.

One of the most important activities of the Society which is done in cooperation with the United Arab Emirates University is organizing the UAE International Date Palm Exhibition for three sessions in a row under the kind sponsorship of H.H. Sheikh Nahyan Mubarak Al Nahyan in 2004, 2006 and 2008. Besides that, the Society organizes scientific field tours to date palm farms which are spread all over the country, and works on strengthening the cooperation and exchanging experiences with similar date palm societies in Oman and Saudi Arabia.

جمعية أصدقاء النخلة

DATE PALM FRIENDS SOCIETY

HAMAD RHAMA ALSHAMSSY

"A man who created balance between sea pearls and land pearls and mastered them"

Sheikh Zayed, may God bless his soul, and H.H.Sheikh Khalifa, God protects Him, had a great role in improving date palm agriculture all over the country till the UAE became the world's No. 1 in that field.

Just as pearls were always in his hands to check them in the past, in those good old days of diving and pearl trade, they are now replaced by dates. Both of them are from the good old days of the heritage of fathers and grandfathers. Though life was simple and modest, our country had men of whom she was proud, due to their awareness and carrying the responsibility of making it safe, challenging the most powerful men around the world in trade, skill, love and giving.

Hamad Rahma Alshamsy was born in Heera/ Sharja in 1931 in a family full of love, giving and belief in a powerful safe country thanks to its sons. He was brought up under the sponsorship of his father, Rahma Bin Abdullah Al Shamsi, son of UAE, a wise man and a reference in pearl dealings, who gained trust of every one including sailors and shipmasters.

In this warm atmosphere of wisdom and experience, Hamad grew up to be a fine young man amidst date palms, writing a new story of unlimited giving, following the footsteps of his father and UAE leaders Sheikh Zayed and Sheikh Rashed "may Allah bless their souls".

Hamad Alshamsy founded his first date palm farm in Thaid/Sharjah in 1984. Until now the farm includes about 2000 date palm trees which give an average production of about 200 tons per year. That means 60-150 kg per one tree according to type and age. All that production is distributed to family members, friends and charity organizations inside and outside the country. The farm contains best date types such as Khlas, Berhi, Zamli, Khneizi, Soltana, Nabtit Seif, Helali, Maktoumi and others.

He inherited his close relationship with date palms from his father and grandfathers, and is always looking for all that is new and useful to serve that blessed tree. He continues his search for excellent date types all over the world to bring it to the UAE in order to increase production. His farm in Thaid is a role model for agricultural activities in the region, in terms of selecting the best species, technical services, irrigation methods, fertilizers etc….

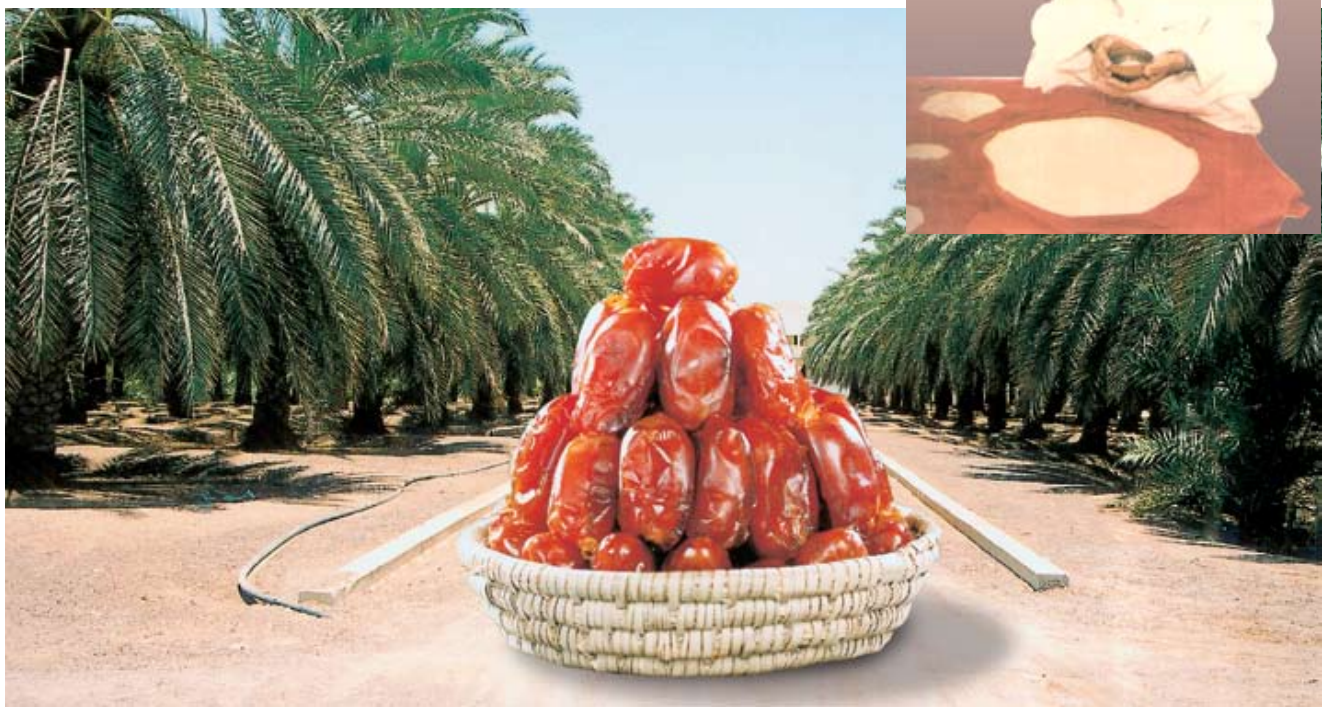
And so, it became a role model and a destination for every one who loves the blessed tree.

"Blessed Tree"magazine met Hamad Rahma Alshamsy and had this interview with him:

1- What does a date palm mean to you? And when did you start being interested in date palms?

A date palm is a blessed tree mentioned various times in the Holy Quran as in (Shake the trunk of the tree towards you, ripe dates will fall upon you) and (And tall palm trees with ranged clusters for Our servants). Also, our prophet Mohammed (PBUH) commended dates when he said (Oh, Aisha, a house that has no dates is a house of hungry people). Dates have been the

His farm in Thaid includes 2000 date palms which produce about 200 tons per year and it is all distributed to family members, friends and charity organizations in and outside the country.



main food for the people of the Arab Island for centuries. It is a food, a medicine and a source of energy, protection and cure. Furthermore, it is the first food that enters a child's stomach after breast feeding (according to prophet Mohamed (PBUH) for the numerous benefits it contains. That is why we are so interested in growing date palms and encourage people to be interested too.

A date palm is also a symbol of giving and goodness for the people of the UAE, and the secret of their survival as well as one of the factors of their loyalty to this kind land. This tree had the greatest impact on the pre-oil days of our lives, as we took from it all the requirements and necessities of life including tools used in houses for living, working in the market, or even fishing. For all that, it deserved to be called the blessed tree. In this regard, Sheikh Zayed Bin Sultan Al Nahyan, May Allah bless his soul, has urged us to pay more attention and care to increasing the numbers of this tree. His great call has found a significant response among all the people of the UAE all around the country until the number of date palms in the UAE reached more than 40 million date palms, according to the statistics of the Ministry of Agriculture.

2 - What is the actual date production, and how about the future of this agriculture in the UAE?

Al Shamsi says that we inherited the cultivation of date palm trees from our fathers and grandfathers. But we imported good species and our real interest in it actually began in the early seventies, then, we have developed the farm in the early eighties. That beginning did not come from nothing, but from the historic heritage of our wise fathers and the wise leadership of the UAE. In fact the United Arab Emirates is one of the first countries concerned with the cultivation of date palms, thanks to Sheikh Zayed bin Sultan Al Nahyan (May Allah bless his soul).

He gave a special care to the date palm, because it occupied a high place in his heart and because of its close link with the overall development process since its glorious start. Palm tree was a friend when we were tired and struggling, and it is a part of our heritage and a source of our food. It took up a large space of his feelings and his attention till it become a sign for development and a basis for the agricultural march which transformed desert lands to green gardens and has raised the rates of planting trees, especially date palm trees, from merely a few trees scattered over the road from Abu Dhabi to Al Ain, to more than forty million date palm trees.

Khalifa Bin Zayed taught us how to love a date palm and to be grateful to it.

On the other hand, His Highness Sheikh Khalifa bin Zayed Al Nahyan, President of the UAE (may Allah protect him) had a great role in supporting the march of development, following Sheikh Zayed's footsteps. He instilled in us the values of originality and nobility to preserve date palm trees and to take care of them. Thus, H.H. provided farmers with all the capabilities needed for increasing date palms and growing its best types, which made the UAE one of the first countries in date production.

This huge national wealth of palm trees in the United Arab Emirates could not have been achieved without the grace of Allah the Almighty and the determination and resolution of His Highness the President of the UAE. Thankfully, the future of the date palm cultivation is bright and we can produce more through giving more attention to the producing farms and this requires providing more water and resisting harmful insects such as the red palm weevil and others, so that farms can work efficiently and on a regular basis.

3- His Highness Sheikh Nahyan Mubarak honored you in the Award ceremony in March 2009. What does this mean to you?

Being honored by his Highness Sheikh Nahyan Mubarak Al Nahyan, Minister of Higher Education and Scientific Research, Chairman of the Board of Trustees of Khalifa International Date Palm Award in the ceremony of honoring the winners of the prize at its first season in March 2009 is a great recognition which makes me proud and encourages me to give more attention to this tree. It is a great responsibility that was passed on to us from our fathers and we shall honestly pass it on as well to our children and grandchildren to continue the march of work and knowledge following the steps of fathers and Sheikhs. On this occasion, we offer our congratulations and gratitude to His Highness Sheikh Khalifa Bin Zayed Al- Nahyan, President of the UAE on the country's well deserved and distinguished winning of the first place in Guinness Book of Records for growing the largest number of date palm trees in the world. We also offer our deepest thanks to His Highness Sheikh Nahyan Mubarak Al Nahyan for the unlimited care and encouragement he gives for us and for every one who loves the blessed tree all over the world through the Foundation of the Award and its Board of Trustees which is successfully chaired by him.

Finally, this is a drop in a sea, as this tree was blessed by Allah for its numerous benefits without which sons of the desert would not have been able to survive in the desert of the Arabian Peninsula for thousands of years", says Hamad Bin Rahma Al Shamsi".

Statistics of the Award First Session 2009

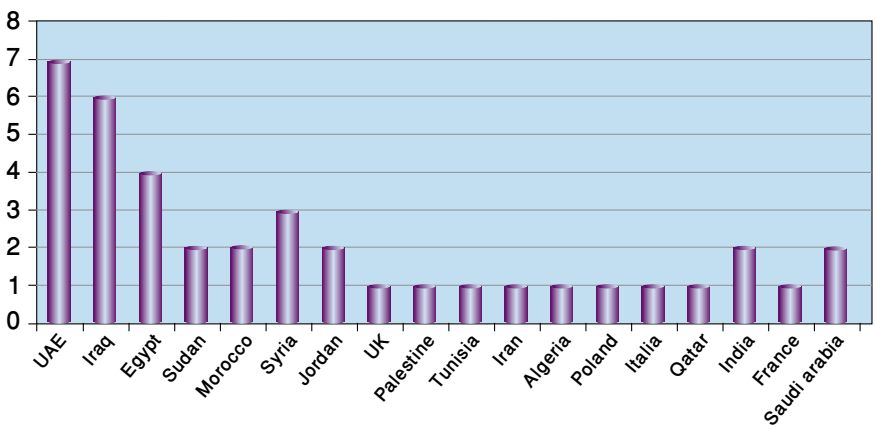
Statistics show that the Khalifa International Date Palm Award received in its first session nominations that mounted to 39 works presented from18 countries.The U.A.E held the highest percentage of participation in a number of categories of the Award that mounted to 7 nominees which equals 17.9 percent .Iraq came in the second position in number of nominees which mounted to 6 nominees 15.4, percent.Egypt held the third position in number of nominees that mounted to 4nominees 10.3,percent ..On the other hand ,the percentage of the ArabCountries 'participation in Khalifa International Date Palm Award in its first session was66.7 percent and consequently the percentage of participation of the remaining world countries mounted to 33.3 percent, as this is considered a good percentage for participants in an international specialized award in its first session.

The first category) research and distinguished studies (scored the highest participation,where nominees were 26 representing 15 countries distributed according to countries participating as follows-:

Iraq 5 nominees,Egypt 4 n0minees,UAE3 nominees ,Sudan and Morocco 2 nominees as1 nominee participated from Syria, Jordan,U.K ,Palestine,Tunisia,Iran,Algeria,Poland,Qutar and Italy.

In the second category),distinguished producers5,(nominees applied 2 ofwhich were from the UAE, 1nominee from Syria,France and India.In the third category) influential and distinguished personalities 8 (nominees applied 2 of which were from the UAE 2, nominees from KSA 1 ,nominee from Jordan ,Iraq ,Syria and India..

His Highness Sheikh Nahyan Mubarak ALNahyan,Minister of Higher Education and Scientific Research,Chairman of Board of Trustees of the Award had endorsed later the scientific committee's results which had concluded sorting results of refereeing for works qualified through the three categories of the award.His Highness commended the wise directives of His Highness Sheikh Khalifa Bin Zayed ALNahyan,the president of the country (God protect him) and his support which counted for the great success the Award gained on the Arab and the International level, in addition to the support of His Highness General Mohammed Bin Zayed ALNahyan,Crown Prince of AbuDhabi ,and Deputy Supreme Commander of Armed Forces for the blessed tree and the continued consolidation for farming and farmers locally..



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MANAGEMENT OF RED PALM WEEVIL

in date palm: An overview

Red Palm Weevil (RPW) *Rhynchophorus ferrugineus* Olivier (Coleoptera: Curculionidae/ Rhynchophoridae/ Dryophthoridae) is a lethal pest of date palms *Phoenix dactylifera* causing wide spread destruction to date plantations in several Middle Eastern countries and also in the South of Spain. Although RPW was first reported on coconut *Cocos nucifera* in South Asia, the pest currently occurs in about 15 per cent of the coconut growing countries while it is reported from nearly 50 per cent of the date palm growing countries (Faleiro, 2006) where it threatens important historic and heritage plantations of the world. Approximately, 5 to 6 per cent of the date palms in the Middle East region are infested with the RPW. (Zaid e.t al., 2002). Besides date palm, RPW is a menace to *Phoenix canariensis* in many European countries where repeated pruning of fronds exposes the palms to egg laying by female weevils. Palms in the initial stage of attack with early larval instars are difficult to detect but easy to treat with insecticide, while palms that are heavily infested and in the late stage of attack, with advanced larval, pupal and adult stages of the pest are comparatively easy to detect but difficult to treat and have often to be eradicated. As RPW is a concealed tissue borer, its management in the field is an intricate task. However, area–wide pheromone based Integrated Pest Management (IPM)

Elche, Spain

Al Hassa, Saudi Arabia

Heritage/ historic date plantations

programmes have successfully combated RPW in several countries, which often require a high level of knowledge and expertise with a good base of highly motivated technical personnel and equipment to implement the programme in the field. This publication envisages to serve as an users guide on the bio-ecology, seasonal abundance, geographical distribution, host range and symptoms of damage, besides an update on its management including pheromone based IPM for RPW, methods of chemical control, enlisting of potential bio-control agents and importance of quarantine in checking its spread.

Bio-ecology

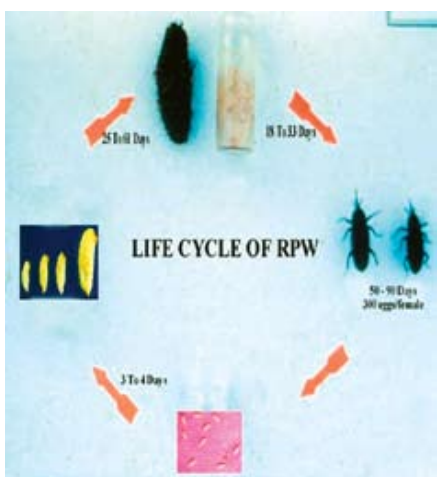
✓Duration of life cycle varies from 145-270 days depending on the availability of food and competition.

✓All stages of the pest are concealed. Only adult

RPW infested countries

India*	Thailand	Oman	Egypt	Spain
Pakistan	Cambodia	UAE		Turkey
Sri Lanka	Vietnam	Saudi Arabia		Italy**
Myanmar	China*	Kuwait		Greece**
	Taiwan	Qatar		France**
	Philippines	Bahrain		
	Malaysia	Israel		
	Indonesia	Palestine		
	Timor	Jordan		
	Papua New Guinea	Iran		
	Solomon Is./Australia	Iraq		

* Grow coconut & date palm ** P. canariensis



Character	Number in days*
No. of eggs/ female	127 –276 Concealed
Incubation period	3 – 4
Larva: Larval period	25 –61 Concealed
Pupal period	18 – 33 Concealed
Adult	48 – 82 Concealed/Exposed
Longivity: Male Female	50 – 90 50 - 90

* Compiled from Faleiro, 2006

Pre-disposing factors for RPW attack


Neglected gardens


Wounds on palmv


Breeding site – cut palm


Closed garden


Several Off-shoots

stage is partially exposed.

- ✓Several overlapping generations comprising of different stages of the pest may be seen in an infested palm.
- ✓RPW has very well adapted to the dry and arid agro-ecosystems of the Middle-East. However, higher levels of humidity within date plantations often leads to increased infestation (Aldryhim and Al- Bukiri ,2003)
- ✓Minimum lethal temperature of egg stage is reported to be 10 0c, while minimum lethal low and high temperature for larva is 5 0c and 40 0c respectively (Martin and Cabello, 2005).
- ✓Adult population is highly aggregated in its spatial distribution, which often result in clusters of infestations (Faleiro et al., 2002)

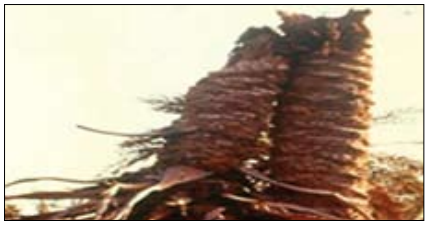
Seasonal abundance

In the Middle-East peak weevil activity occurs during April to May followed by a smaller peak from October to November.

Eggs laid during the first peak (April to May) usually result in many infestations during the subsequent summer months, while eggs of the second peak (October to November) often do not hatch due to the cold winter that follows, resulting in fewer infestation during winter.

Geographical distribution and climatic preference

- ✓With the exception of the Americas, RPW is reported from all the other continents.
- ✓World wide 15 and 50 per cent of coconut


A toppled palm due to RPW attack


Palm tissue exudates by feeding grubs


Phoenix dactylifera


Phoenix canariensis


Cocos nucifera

RPW preferred palm species

and date palm growing countries are infested, respectively.

RPW occurs in diverse climatic zones of the world and has its home in the tropical, coastal, monsoon, equatorial climatic regions of South and South East Asia. However, it has adapted well to the arid and Mediterranean climatic regions of the Middle East and Europe respectively.

✓There are no reports of RPW from countries in the cold and high mountain climatic regions of the world.

Host range, pre-disposing factors of attack and symptoms of damage

✓RPW is reported to attack 17 species of palms but causes wide spread damage in coconut, date palm and *P. canariensis.*

✓Usually attacks young palms less than 20 years old.

✓Maximum damage (75%) is reported to occur in palms 5-15 years old.

✓Wounds on the palm coupled with neglected farms, closed gardens inaccessible to inspection, beheaded or cut palms and production too many off-shoots pre-dispose the palms for attack by RPW.

RPW preferred palm Species

Depending on the stage of attack infested palms exhibit one or more of the following symptoms.

✓Presence of tunnels on the trunk and base of frond petiole

✓Gnawing sound due to feeding by grubs

✓Oozing out of thick brown fluid from the tunnels

✓ Appearance of chewed plant tissues in and around opening of tunnels with a typical fermented odour

✓Fallen empty cocoons of pupae and dead adults around a heavily infested palm

Eradicating severely RPW infested palms

✓Breaking of the trunk or toppling of the crown in case of severe and prolonged infestation.

✓Drying of off-shoots in date palm

Pheromone trap design and operational tips

✓Fabricate four windows (1.5x 5cm sq) traps, using 5 L capacity plastic buckets with rough outer surface

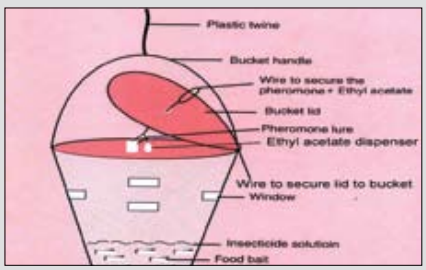
✓Load traps with RPW pheromone lure + ethyl acetate attached to the lid of the bucket

✓Place 200g of kairomone releasing food bait in the bucket containing 1L of non-repellant insecticide (0.5% carbofuran 3G TM)

✓Place traps under shade of plant canopy, either at ground level or on trunks of old palms (more than 20 years old) 1m from ground level.

✓For surveillance programmes, a density of at

Weevils captured in RPW pheromone trap



Model RPW pheromone trap

RPW pheromone lure dispensers

Drilling RPW infested palm for injecting insecticide

Drilling RPW infested palm for injecting insecticide

Potential bio-control agents

Sr. No.	Potential RPW Biocontrol Agents	Scientific Name
1	Insects (Wasp, Earwig)	*Scolia erratica , Sarcophaga fuscicauda, Chelisoches moris*
2	Bacteria	*Pseudomonas aeruginosa, Bacillus sp., Serratia sp. B. sphaericus, B. mgaterium, B. laterosporus, and B. thuringinsis,*
3	Fungus	*Beauveria bassiana, Metarhizium anisoplieae, and Beauveria sp.*
4	Virus	Cytoplasmic Polyhedrosis Virus (CPV),
5	Yeast	------
6	Entomo-Pathogenic Nematodes (EPN)	*Heterorbhabditis spp., Steinernema abbasi, Heterorbhabditis indicus, Teratorhabditis palmarum, Steinerema sp., H. indica, and Rhabditis sp.*
7	Birds (Indian tree pie bird and Crow pheasant bird)	*Dendrocitta vagabunda parvula*

least 1 trap per 100 h may be adopted, while in mass trapping programmes, set traps at a density of 1-2 traps per hectare which may be enhanced if weevils emerging from infested palms are not captured and such infestations go undetected

- ✓Service the traps in the field regularly at weekly intervals by replacing food bait/ insecticide solution and discarding the trapped weevils
- ✓Replace the pheromone/ethyl acetate lures before these are exhausted
- ✓Trapping efficiency can be enhanced by taking up periodic cover sprays with insecticide on palms in the vicinity (50m radius) of the pheromone traps

Pheromone based RPW-IPM

- ✓Set surveillance / monitor traps to gauge the situation.
- ✓Implement mass trapping / area–wide management (based on infestation reports and weevil captures in monitor traps)
- ✓Check palms around traps recording weevil captures on a weekly basis
- ✓Treat infested palms (curative control-stem injection)
- ✓Eradicate heavily infested palms
- ✓Take-up preventive insecticidal sprays/showers in and around eradicated/treated palms and also on young palms around traps recording repeated weevil captures.
- ✓Go in for repeat checking of palms around traps recording high weevil captures and in and around gardens where infested palms are eradicated.
- ✓Implement other components of the routine RPW-IPM programme (Clean cultivation, quarantine, training and extension, treating breeding sites and inspection of closed gardens)

Chemical control methods

In area–wide management of RPW insecticides are used to prevent infestation or cure infested palms. Following are the chemical control methods widely adopted in the management of RPW.

Dipping off-shoots in insecticide solution before transport (A quarantine pre-requisite)

Spread of RPW by transporting palms in the susceptible age group

✓Preventive – Based on trap capture / infestation reports
- Frond axil filling (Use insecticides that repel RPW adults)
- Spraying / Soaking (Recommended for endemic pockets ,with persistent weevil captures in traps and high infestation level)
- Protecting wounds (Spray insecticide when the wound is fresh after removal of fronds / off shoots)
- Dipping offshoots in insecticide before transport (A quarantine requirement)

✓Curative – Treating infested palms
✓Trunk Injection (Repeat treatment every 15 days until the ooze stops)
✓Fumigation (use 1-2 aluminum phosphide tablets per infested palm depending on the size of the cavity)

✓Trunk injection (1% CarbarylTM/ TrichlorphonTM/ DimethoateTM/ ChlorpyriphosTM) is to be taken up in infested palms by making 3-5 slanting holes 15cm deep just above the infested portion so as to reach the cavity. Pour insecticide solution (0.5-1.0 L) into the holes, which are to be sealed with moist soil.

Quarantine and RPW-IPM

✓Wherever possible restrict /stop the movement of planting material from garden to garden with in an infested area and also from an infested region to non-infested areas
✓Transportation of palms in the most preferred age group of 5-15 years may be banned
✓Ensure that only insecticide treated and certified pest free planting material is transported
✓Certification of pest free planting material may be ensured by following pre-departure and post-entry observations for a minimum of 3 and 6 months, respectively.

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IPM in practice

THE OIL PALM STORY

Abstract

This presentation is derived from a recent more detailed and fully referenced review - Wood, Brian J, in press. Pest control in Malaysia's perennial crops: a half century perspective tracking the pathway to integrated pest management. Integrated Pest Management Reviews, (2004).

Introduction

Contrary to convention, I start with some biographical detail in order to emphasise that my role has been in the practice of crop protection for plantation companies. I have not had a brief for any particular approach, neither from a chemical company nor any other institutional affiliation. The theme was responsibility for applying control, plus research and development on methods, in citrus in Cyprus 1957 – 62, and then in Malayan (later Malaysian) oil palms. The relevance of these events, starting nearly 50 years ago, to current approaches in date palms, might be questioned. However, a key feature was the impact of spraying broad spectrum long residual contact (bslrc) insecticides. Briefly, spraying could disrupt the balance of natural control by insect parasites and predators, so whilst control was obtained from a properly applied spray (correct timing and complete coverage), still each ensured that further spray would be needed (the "vicious circle"). This understanding began with the experience in citrus, which additionally had shown how non-disruptive measures (including selective chemicals) could restore balance and maintain control where needed, economically with minimum input. I continued to be involved directly in oil palms until 1990, and the holistic approach in the extensive oil palm agroecosystem has continued in many hands to the present day. This story outlines the developments, in parallel with the global philosophy and terminology of IPM.

Leaf eating caterpillars in oil palms

Early outbreak surges. In the late 50s, serious outbreaks of leaf eating caterpillars were affecting Malaya's developing oil palm industry. By 1962, when there was around 250,000 ha, all as large plantations, several instances of near complete defoliation had occurred. Faced with such

unprecedented losses, two issues predominated, namely to control the immediate outbreaks, and to find causes. The first, of course, took precedence with the growers, but the second might lead to avoiding such attacks in future. One early task was to look at the life cycles and ecology of the pest groups, of which two predominated. Essential points are – bagworms (Psychidae) have a case made up of leaf tissue from the host plant, and females remain within that, becoming a sac of eggs, from a few hundred to thousands, depending on species. This means dispersal is limited to spread from a centre, with new infestation "seeded" by young caterpillars carried on wind currents, or some other means. Nettle caterpillars (Limacodidae) have an exposed caterpillar, many species armed with urticating spines. Cocoons form on the ground, and both sexes become free-flying moths, so spread from generation to generation is more even. They lay numerous eggs, in batches. Three bagworm species and about five or six nettle caterpillars occurred in outbreak numbers.

Natural balance – the essential feature of the agroecosystem. These caterpillars were always present in small numbers and clearly could find all they needed in oil palms to complete a life cycle. The multiplication potential, with many eggs, and a generation time of a few weeks to 3 months, was huge, and the real question was not why were there outbreaks, but why are the caterpillars usually rare? The evidence then, and reinforced by all subsequent events and investigations, was that it was due to insect natural enemies, which themselves shared this increase potential, in dynamic balance. The outbreaks had been set off by bslrcs that eliminated the natural enemies more thoroughly, and/or differentially slowed down their reestablishment. Numerous hymenopteran and dipteran parasites, as well as predatory bugs and beetles, appeared. As oil palms grow up, the canopy gets very dense, becoming fully interlocking with a base at about 2 metres by year 6. It gains a further metre every 3 years or so through the planting cycle, which is usually up to about 25 years. Spraying with the ground machinery then available was thus very difficult. This added to the problem, in that patchy coverage by residual contact insecticides removes natural enemies more effectively than it does the pests, because the former are inherently mobile and exploratory, and the pests more static. Many caterpillars and other leaf eating insects, apart from those that appeared in outbreaks, had this increase potential. This natural balance between many potentially totally defoliating pests and their insect natural enemies is of particular significance in the constant conditions of the tropics, and in perennial crops.

Control by selective chemicals. The immediate need was to find selective chemicals and apply them properly to terminate outbreaks without rebound. Chemicals tend to be selective if they lack at least one of the adverse features of the bslrcs, viz have a narrow spectrum (especially sparing Hymenoptera), a short residue, or no lethal contact effect (stomach acting). Good effects were obtained immediately by aerial applications of lead arsenate (stomach poison) and subsequently triclorfon (narrow spectrum, fast fading contact residues).

The early spraying. If continuous good natural control was a characteristic, why spray in the first place? Reasons included minor upsurge of the pests from small fluctuations in the balance, or its disruption by environmental factors, such as bare ground policy (so no flowers for adult parasites to feed). A further reason was that growers, hearing news about big outbreaks in oil palms, tended to apply "precautionary" or "prophylactic" sprays. Sometimes, it was outbreaks of pests of other groups, generally not serious, that were treated. Other factors may disrupt balance in some circumstances. These include road dust (which differentially kills natural enemies because by their mobility, their outer covering is punctured, so destroying the protection from dehydration), and ants, which can disturb natural enemies. These two need to be considered, although there is no evidence of a regular adverse effect in the oil palm agroecosystem - ants, in fact, can be important predators, a role that still merits further elucidation.

Continuance of outbreak. Often, outbreaks settled as soon as the spraying of bslrcs ceased, but this was not always so. If the potential of insect enemies is so good, why was there this tendency to continue? Reasons adduced included the fact that "normally" the pests (as hosts) were rare, and therefore so were their enemies, which accordingly took some time to "catch up". Further, in the continuously favourable conditions, there has been no evolution of an exact synchronicity between the life cycles of the pests and their enemies. The latter on emergence have an equal chance of finding a host at a suitable stage at any time (Continuous Generation Mode - CGM). In outbreaks, the pests tend to

be nearly all at about the same stage (Discrete - DGM), maintaining the disadvantage to the enemies, and often leading to resurgence after the outbreaks appear to have settled. Also, the pesticide residues may remain patchily, delaying the full reappearance of enemies, as outlined above.

The insecticidal check technique. This technique was first developed for (relatively static) scale insects on citrus trees not yet interlocking. Individual trees sprayed with a bslrc showed rapid increase of the scales, whilst on the other trees they remained well below damaging numbers. Oil palms soon interlock, and the leaf eaters can spread more easily than scales, so the technique was adapted by spraying a plot of about 0.3ha with a broad spectrum organochlorine. At the start the pest was evenly spread at moderate numbers. It then clearly built up much higher in the spayed plot, although there was gradual spread outwards. This continued over the several months (3 bagworm generations) of the trial. This confirmed objectively that pesticides can cause outbreaks.

Other examples

Very similar stories with bslrcs are well documented on a range of crops. Some were in a similar era, eg cocoa in Malaysia, tea in (then) Ceylon, cotton in Peru, coffee in Africa, oil palm in Indonesia, Africa and S America. This was not only with perennials but also rice and vegetables in SEA. Some have happened in the last decade, eg tea in India, and horticultural crops in Kenya and Gambia.

IPM develops

The approach built up in oil palms, centering on the natural balance, has continued to the present, developing in parallel with the terminology. In the early period, we referred to "ecological approaches" to control. Up to the mid-60s, integrated control implied chemical control that could be applied to supplement biological control. Then it came to cover all compatible measures. Integrated pest management was used from about 1976. The contributions from these tropical crop experiences especially included recognition of the role of background natural control, and selective pesticide techniques.

A helpful ecological categorization of pests refers to their status in existing agronomic conditions (without insecticide application) as Key (regularly a problem), Occasional (usually under good natural control but sometimes flaring up) and Potential (can feed in the crop but only in sub-economic numbers, or rare). Occasional and potential pests both may become "Induced". It can be surprising to many people, even those closely involved in crop entomology, how many very serious and regularly occurring pests are, in fact, induced, their threat kept going by the control measures applied.

IPM technology in oil palm

After the urgency of dealing with the leaf eating caterpillars by IPM techniques, other aspects have been developed for the whole range of oil palm pests. IPM techniques include –

Selective chemicals - in blanket sprays
- Narrow spectrum
- Short lived (fugitive) residue
- Non-contact

Chemicals with potential side-effects minimized by restricted application
- Baits
- Topical
- Trunk injection

Cultural/agronomic

Semiochemical
- Pheromones
- Antifeedants
- Moult disrupters

Biological
- Enhance the environment
- Mass rear/disseminate
- Import

Chemical. Selectivity in chemicals is relative. It means killing the pests more thoroughly and/or for longer than their enemies. Balance in the wet tropics is particularly stable, and some treatments that would be disruptive in more sensitive agroecosystems are suitable in some tropical ones. The ultimate proof is in repeated use. On the other hand, the problems arising if balance is disrupted may be more serious. It is best to maximize kill, in order most rapidly to restore balance or to control key pests. This means that spraying, if it has to be done, should be optimized for coverage, timing, etc. Selective spray programmes have been worked out for a range of occasional pests, such as grasshoppers, cockchafers, red spider mites, and thrips.

In restricted application, baits have been used for mole crickets, grasshoppers and cutworm-like caterpillars in nurseries. Topical application of bslrcs has been used for termites, although now, other toxicological/environmental considerations restrict the possibility, and alternatives with baits are being developed for large scale new plantings on peat soils, where these pests are most common. Trunk injection of systemic pesticides is a very elegant technique in palms, where placement into one hole in the stem means the chemical is carried to all fronds. Excellent control of outbreaks of occasional pests has been achieved. Where the operation is "industrialized", by working several drills from a tractor drawn generator, followed up immediately by a separate injecting team, large areas can be done rapidly. The cost is less than

by any other means, whilst virtually eliminating risk of side-effect, including environmental and toxicological problems. Large scale campaigns have been carried out against the leaf eating caterpillars in Malaysia & Indonesia, against a leaf mining hispid beetle in West Africa, and a long-horned grasshopper in Papua New Guinea.

Cultural. The rhinoceros beetle, Oryctes rhinoceros, can do heavy damage to the crowns of young palms, especially in replantings, because the old stems become breeding sites as they rot down. Planters noticed that damage was less if there was dense ground vegetation cover. Trials clearly showed a dramatic difference, with smaller numbers of grubs etc. in breeding sites, and direct protection of young palms from attack. This is the preferred control method, particularly since it is in any case the best agronomic option.

Semiochemicals. Sometimes, ground vegetation cover fails (see Cultural, above), and traps with aggregating pheromone are used against O rhinoceros. Antifeedants and life cycle disrupting products have been tested against some pests, although none has yet been incorporated into any regular practice.

Biological control. Active possibilities include improving the environment for natural enemies to operate. This includes avoiding bslrcs of course, and keeping some ground vegetation for flowers to feed adult parasitic insects. Dissemination of natural controls includes application of a suspension of ground up bodies of insects that have died of a virus, which has had good effect against some nettle caterpillars. There has been little pressure in oil palms to pursue "classical biological control" by importation and establishment of exotic natural enemies.

The economic perspective

An important set of precepts of IPM is – "consider the agroecosystem" and "observe economic damage levels". The foregoing shows how the first has played its part in oil palm IPM. Parallel attention to economics has not been neglected. Yield patterns after severe leaf loss, and trials of graded simulated pest defoliation, show that heavy leaf loss severely pulls down yield, and must be avoided. However, small leaf loss can be tolerated, especially if compared with the cost of any effort relentlessly to eliminate every last bit of damage. Quite noticeable leaf area removal can be withstood in young palms before there is detectable yield loss. This gives added confidence to any IPM method that allows some toleration of limited damage.

Monitoring can help to determine whether and when treatments may be helpful. Two-stage systems have been devised, with general alert at all times, and setting up of appropriate counting when any crisis may be imminent. Counts may be of pests themselves, or signs of their incidence (mainly, their damage). A common intuitive tendency is to overdo sample size – the aim is a reliable indication of the status of the pest in a given area. Economic damage thresholds have been assigned for some pests, but need flexible interpretation within the agroecosystem subtleties - particularly whether a given level is

in a declining or increasing trend. Monitoring is very useful once a treatment is decided upon, to ensure that it is applied at the most vulnerable stage in the life cycle of the pest.

Conclusion - when to implement IPM

IPM is not an esoteric technology that requires "ultimate answers" before it can be applied. The best management practice requires knowledge of the principles, applied in the particular agroecosystem to the best extent currently possible, whilst avoiding making things worse by non-IPM (disruptive) procedures. Obviously the capability to maintain good control does continue to improve as the ecology becomes better understood. The induced outbreaks themselves are an important source of ecological information, as are responses to measures taken, in general. The history described here of IPM application to the now over 3 million ha oil palms in Malaysia, bears good testimony to all of that.

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Integrated Pest Management

Experiences in pakistan

Abstract

Research and development on IPM was initiated in Pakistan in the 70's. However, efforts to implement IPM at the farm level did not bear fruit. A major obstacle has been the mindset at the policy level to increase crop production to feed the ever-increasing population. Pesticides became a major instrument of increasing production leading to 'pesticide treadmill' situation. Although IPM-FFS "Vehari Model" clearly demonstrated that IPM could be implemented on a large scale at the farm level, a positive enabling environment did not exist. An analysis of pesticide policy through a UNDP-FAO Policy Reform Project paved the way for the establishment of a National IPM Programme and provided instruments to scale up the Farmer-led IPM through integration of international and national efforts on various fronts. The Policy Study has shown that Pakistan's laissez-faire approach to pesticide policy has imposed substantial costs on the national economy that have fallen most heavily on the poorest of the poor segments of the society. The pesticide dependence has given rise to costly negative externalities in the form of damage to human health, to agricultural production systems and to the environment. The study has underscored the need to remove incentives for pesticide overuse, create new incentives for farmers to develop skills in sustainable crop production including pest management, provide unbiased science based information on pesticides and IPM and strictly enforce clear and consistent pesticide rules and regulations. There is a paradigm shift

in the Government thinking leading to efforts on reforming the Pesticide Act and rules, taking in to consideration the health and environmental concerns and international agreements, and adopting IPM as a strategic option to reduce pesticide use. Thus IPM has been institutionalised through the establishment of a National IPM Programme. IPM is now considered as one of the most appropriate approaches to provide a sound transfer of knowledge system in the country's agriculture once it is used as an entry point to transfer crop protection technologies. The future trends as apposed to past, appear to be: i) a holistic IPM based on systems approach, ii) a large scale field implementation focusing on farmer empowerment through Farmer Field School Approach, iii) a strong commitment from Government for IPM as a strategic option to rationalize use of pesticides, iv) increased consciousness on the part of the consumers about toxic affects of pesticides on Society's health and environment with a resultant enabling environment for IPM, v) a continued "negative expansionist marketing and dumping of pesticide" attitude of agro-chemical industry due to tighter and stricter control in the developed countries, vi) attraction of GMO's appearing as a silver bullet syndrome, and vii) trade and globalisation increasingly playing a role in the liberalization of pesticide market.

Introduction

Pesticides use, in Pakistan, began in the fifties, but surprisingly the rules and regulations were formulated and approved much later in 1971 and 1973. Until 1980 the pesticides were subsidized and Plant Protection Department was responsible for pesticide import and their distribution in the country through national agricultural extension network. In 1980, the pesticide business was transferred to private sector, following which a considerable increase in pesticide use occurred over the years (Ahmad et al, 2002); from 665 metric tons in 1980 to 69897 metric tons in 2002, without significant gains in the yield of crops such as cotton, which consumes about 54% of the total pesticides used. However, there is 85% reduction in real value from base year, 1980. Per unit price of pesticides also decreased drastically since 1993 after the introduction of generics. The role of private sector in promoting the production and use of pesticides was found to be tremendous. The private sector also took full advantage of government's pesticide oriented policies (Khan et al, 2002).

The increase in use of pesticides not only drains the exchequer, but also presents a growing threat to the people and environment of the country. Increased pesticide use has created growing resistance among pests and destroyed natural predators. Unplanned use of chemicals resulted in environmental pollution and un-economical returns on the costly investments. The pressure to maximize outputs is enormous on low income and resource poor small farms. They have, therefore, little regard for degradation of natural resources, health risks and future productivity. On the other hand, roughly, 85 to 90 percent of pesticides applied in agriculture never reach the target organism; instead they become

dispersed through the air, water and soil. There is an ecological principle that the poison we put into the environment comes right back to us in our air, water and food. A depleted and polluted environment impact the poor by increasing health problems and lowering the productivity of the natural resources off which they often must live (Khan et al, 2002).

Pesticide policy analysis - a vehicle for IPM implementation

In Pakistan, research and development on IPM was initiated in the 70's. However, efforts to implement IPM at the farm level did not bear fruit. Pesticides became a major instrument of increasing production leading to 'pesticide treadmill' situation. Although an IPM-FFS model implemented in 1996 - popularly known as "Vehari Model", clearly demonstrated that IPM could be implemented on a large scale at the farm level, a positive enabling environment did not exist. An analysis of pesticide policy through a UNDP-FAO Policy Reform Project during 2000 (UNDP, 2001) and the initial input from FAO-EU IPM Programme for Cotton in Asia paved the way for the establishment of a National IPM Programme and provided instruments to scale up the Farmer-led IPM through integration of international and national efforts on various fronts (Ahmad, 2003b; Soomro and Ahmad, 2002).

Pesticide policy analysis results shows sharp increase in external costs related to agriculture pesticide use and these costs fallen heavily on the poorer groups of the society. The economic analysis of pesticide use in Pakistan shows a benefit cost ratio of only 0.43 while including external costs of pesticide use to the society and even excluding these costs yielded a benefit cost ratio of 1.14 only. These results raise some doubts whether the current level of pesticide use in cotton or for that matter in other crops is economically justified (Ahmad, 2003b).

The pesticide industry has a very strong influence in the farming community. By reducing dependence on pesticides, IPM would reduce costs of production and could lead to improved rural health. Thus newly established National IPM Programme (Nat-IPM), based at the National Agricultural Research Centre (NARC) - an in-house research establishment of the Pakistan Agriculture Research Council (PARC) – the Apex NARS Research Coordination body of the Ministry of Food, Agriculture and Livestock, would play a crucial role in this direction (Ahmad et al, 2002; Ahmad, 2003a). Given the low capacity of agriculture extension departments to cater a large population of farmers, the National IPM Programme was challenged with a task of reaching 5.0 million farmers in the Country.

Farmer-led national IPM programme accomplishments

Since 2001 Nat-IPM with the technical support of FAO is implementing the following three projects using cotton as an entry crop as largest pesticide

use is in this crop. The experience gained is being extended to other crops moving from commodity to systems approach.

1. FAO-EU IPM Programme for Cotton in Asia: A Regional Project implemented in six countries; Bangladesh, China, India, Pakistan, Philippines and Vietnam.
2. FAO-ADB Technical Assistance for Cotton IPM in Pakistan
3. FAO-AGFUND Project on Pesticide Risk Reduction in Women in Pakistan.

The implementation of FAO-EU Cotton IPM Programme was initiated by organizing two TOF and 20 FFS in Sindh and revival of five old FFS of Vehari Project during 2001 cotton season. During 2002, two more TOF were organized at Mirpur Khas Sindh and Bhawalpur Punjab, while 104 FFS were organized in seven districts of Sindh. The activity was further expanded in 2003 with three more TOF for Field Assistants at D.G. Khan, Lodhran and Vehari in Punjab, a total of 174 FFS were organized in Sindh (130), Punjab (33) and Balochistan (11).

Thus by 2003, the Programme has organized 7 season-long trainings and trained 258 extension staff, researchers, NGO personnel and farmers as facilitators. It also organized 303 FFS and trained 7781 farmers including 156 females in Sindh (Ghotki, Sukkur, Khairpur, Naushehro Feroze, Nawabshah, Sanghar, Mirpur Khas, Hyderabad and Dadu districts), Punjab (Bahawalpur, Lodhran, Vehari and DG Khan) and Balochistan (Khuzdar, Jafferabad, Naseerabad, Sibi, Bolan and Lora Lai). The Programme in contrast to the FAO's residential TOT/FFS model modified it to be non-residential according to the socio-cultural requirement of the participants where the trainees were returning to their homes every evening; the experiment proved to be successful.

FFS results show that by practicing IPM, farmers have reduced pesticide use by 87% while expenditure on fertilizers have reduced by 26.5%. On the average, their yield was up by 10.5%, input expenditure was less by 22.3% and the gross margin was up by 46%. Only a case study of 90 FFS in six districts of Sindh Province during 2002 cotton season showed that FFS trained farmers adopted IPM technology and got higher profit because of low use of pesticides, fertilizers, irrigation water and intercultural practices. On the average, IPM farmers earned Rs. 8,243/- per ha more net profit as compared to their non-adopter colleagues (Soomro et al, 2003a). It is estimated that if we adopt the IPM technology only on cotton acreage throughout the country we may save Rs. 25.7 billion to the national exchequer. Apart from the above visible benefits IPM approach, if widely practiced, the country could overcome a lot of other problems such as environmental pollution, food contamination; accidental deaths & suicides and diseases/ disorders caused by pesticides, disturbance of agro-ecosystems, pest outbreaks and suppressed biodiversity, and more importantly bring about the change in social behavior of our farmer/rural communities (Soomro et al, 2003b).

Sustainable IPM programme establishment goals

FFS-based IPM approach in Pakistan has successfully switched from project to Programme phase and preparing for entering into a movement state. This will lead to empowerment of farming communities at gross root level, network of community organization, and effective linkages between research, extension, development agencies and formation of community organizations. The key element to enter into this desirable phase is to have a highly skilled team of dedicated facilitators. A core team of 20 expert facilitators at national and regional levels is evolved through TOF and FFS implementation processes, involvements of international experts on facilitation skills, evaluation of the use of facilitation skills and exposure of facilitators to cross-cultural and different agro-ecological environments. In the movement phase our focus is to take FFS approach out of merely plant protection and put it into mainstream extension, and further develop FFS into sustainable farmer groups that can continue to generate new knowledge in a self-reliant manner and to undertake several other developmental initiatives.

The Programme has experimented with many concepts to achieve the sustainability and social equity goals. All these concepts are at preliminary phases of testing and evolution to strengthen Programme footing for expanding IPM approach from commodity orientation to system focuses, addressing gender issues, institutionalizing farmer to farmer knowledge/skills transfers, participatory community development, sustainable use of services of IPM facilitators for promoting farmers science and establishing a net work of FFS based community organizations. The validation of new Programme initiative is further explained as under:

Steps Towards Community IPM

The Sindh provincial extension department deputed the services of extension officers for training in TOF for establishing FFS in different regions. However, such cooperation was lacking from Punjab extension during initial Programme implementation phases. In Sindh also a saturation point was reached quickly, as the available manpower resources were greatly exhausted. It was realized at Programme management level that the goals of reaching a critical mass of the cotton growers, both in Sindh and Punjab provinces, are hard to achieve only by banking upon public sector human resources. Farmer-to-Farmer transfer of IPM knowledge and skills was experimented through organizing Farmers TOF and Women Open Schools (WOS). A team of male and female farmers facilitators was trained to achieve cost effective FFS-based IPM programme implementations. The community IPM concept is evolved through programme investments on producing a cadre of male and female farmers facilitators and a network of community organizations.

Community IPM would be a step forward towards sustaining the use of the services of FFS facilitators, development of WOS, TOF and FFS

on self help basis and establishment of network of regional and national level facilitators and farming community organizations. The farmers who graduated during 2003 as trained facilitators from Farmers TOF organized and registered themselves as Farmers Facilitator Organizations (FFO) in Punjab and Sindh provinces. The Women Facilitators trained through Women Open Schools (WOS) registered themselves as Women Agriculture Development Organization (WADO) in Sindh. The facilitators from Farmers Facilitator Organizations (FFO) organized farmer congresses in Bhawalpur (Punjab), Sukkur (Upper Sindh) and Karachi (Lower Sindh) where a network of Community Organizations of Farmers was established at village, tehsil, district, province and national levels. These organizational initiatives by farmers and facilitators were brought forward to promote community IPM on self-help basis and to link them to national and international NGOs for achieving other developmental goals as well. These are fresh initiatives and have the potentiality for developing required technical capability and financial strength with the passage of time. The National IPM Programme will be providing technical support to these young organizations for achieving maturity and sustainability for emerging as a well knitted independent functioning units.

Capacity Building Of National Institutions

In the EU funded IPM programme the manpower of the provincial extension institutions is trained as facilitators. The prospects of the use of this trained manpower by respective provincial and local governments is vital in the institutionalization of IPM-based extension concepts. The Governments at different levels are convinced with the initial achievements of the programme and policies as well as institutional reforms are in process. The federal government has provided some basic resources for 5 years (2.31 million US$) to strengthen FFS-based IPM programme implementation at national levels. Similarly, Punjab government is heading towards establishing its own FFS-based IPM programme. Advocacy of the outcomes of IPM programme implementation in Pakistan and the technical support from Nat-IPM programme to formulate proposal by provincial extension helped in this direction. Similar efforts would be required towards the institutionalization of FFS-based IPM procedures by other provincial and local government systems. These national and regional initiatives on IPM implementation are very important step towards the institutionalization of this approach and the national programme will be providing technical back-up support for sound programme planning and quality implementations.

The provision of expert facilitators and strong follow-up on the use of facilitation skills, during large-scale expansion of IPM programme in provinces or regions, would be the challenges for national IPM programme. Programme implementation at different levels without proper technical know how could go in the wrong direction and hence wrong conclusion could be drawn which would be detrimental for these new programme initiatives. National IPM Programme will be carrying out follow-up workshops on facilitation skills, practicum to upgrade the experimentation skills and participatory planning and appropriate interventions in the FFS and TOF curriculum, and devising new curriculum based on system aspects of crops management. The transition of expertise from National IPM Programme to provincial and local governments would be the end goal of the institutional capacity building at various levels.

Gender Absorption

Pakistani women play a significant role in agriculture with a participation rate of about 43% in a number of on-farm activities (Habib, 1996). Some even help their men to mix and prepare pesticide solutions, but due to certain socio-cultural reasons they could not participate side by side with male farmers in the regular IPM FFS. On the other hand, studies on health hazards of pesticides to women cotton pickers showed that out of 2.6 million pickers 84% got sick because of exposure to pesticides used on cotton crop during on-farm activities (UNDP, 2001). Thus a special pilot project *"Pesticide Risk Reduction for Women in Pakistan"* for awareness of rural women was developed with the support of FAO and Arab Gulf Programme for United Nations Development Organization (AGFUND). Objective of the study was to train rural women on pesticide exposure and risk reduction within their traditional, cultural and socio-economic framework/setup as the Pakistani women would not participate in regular cotton IPM Farmer Field Schools (FFS) like in other participating countries (Ahmad et al, 2003).

The activity was implemented through workshops, women facilitators training (WFT) and women open schools (WOS) conducted on the pattern of IPM TOF/FFS in districts of Khairpur and Sukkur in 2002 and in districts of Khairpur, Sukkur, Naushehro Feroze and Bahawalpur in 2003. Thus a total of 38 women facilitators were trained in WFT and 493 women farm workers were trained in pesticide risk reduction through 14 WOS in 2002 and 19 in 2003 in Sindh (15) and Punjab (4). The WOS were run for one complete growing season where 25-30 women attend 3-4 hour weekly session at a place (either a house, a guest room, a school or in field), work in groups through discovery based learning in the field (Self-monitoring of acute pesticide poisoning) The pilot programme has developed a team of women facilitators and trained rural women who can serve as a lead group in capacity building of local communities. This pilot study helped to explore the role of Pakistani women in agriculture especially cotton farming community that could be utilized for future planning of such trainings on large scale.

The participating women facilitators were encouraged and promoted to interact with male facilitators and farmers apart from female farmers so as to develop a culture of tolerance and working together side by side. This also helped in spreading the message and understanding of IPM within and between the farm families. As a result of WOS activity, a welfare organization named, "Al-Noor Rural Development Organization" was also

formed in Jiskani Village of Khairpur district with the aim to enhance technical skills of rural poor women of the district so that they could earn a living on their own. "Zubeda Vocational Training Centre", named after the facilitator Ms. Zubeda Jiskani, who voluntarily initiated the activity.

After initial training of women facilitators through WOS in Sindh and Punjab, it is emerged to organize a season-long TOF for women. The gender study on women role in decision-making, consultation in decisions making and her role as laborer has strongly highlighted the need to more intensively involve rural women in TOF, FFS and WOS types of trainings. The complementary role of women in crop management, livestock raising, and small scale enterprises (sewing, embroidery etc.) development is further understood during 2003 through initial experimentation. The local government funding to foster IPM related management and developmental projects in Sindh, is a solid outcome towards strong practical linkage establishment between IPM and local institutions. National IPM Programme has to provide a specialized support and technical back up to sustain these women related crop management, rural livelihood and health initiatives.

Institutionalization of Farmers to Farmer Education

Farmers always performed a catalyst role in technology transfers that has been proved through several adoption studies. Generally, large or risk taking farmers are the early adopters and followed by the neighboring farming communities. Training of farmers as facilitators is an effort to institutionalize these informal technology transfer mechanisms. The initial effort shows a great potentiality towards low cost and sustainable transfer of knowledge, skills and technological packages. The farmers as facilitators have proved themselves more responsible, committed and motivated to deliver in an organized manner.

Farmer to farmer education was specifically experimented during 2003 cotton season. Two farmers TOF were organized one for each Sindh and Punjab provinces. The graduate farmers facilitators have organized themselves and prepared a low cost FFS implementation plan for the year 2004. They have also been able to implement the season long wheat FFS in Punjab as follow-up step with last season cotton FFS. Successful running of F2FS by the project in the 2003 has also created great interest among local/ provincial Governments and NGOs and they are positively thinking to induct the farmer-farmer education in their extension system and rural development programmes. These preliminary successes are achieved through technical backup from National IPM Programme in first rigorously train farmers as expert facilitators and to provide technical back-up in conducting FFS and FTOF during coming seasons.

IPM from Commodity to Cropping System Approach

The current EU-FAO IPM programme is specific to cotton crop only. However, the farming communities have shown keen interest to

participate in the FFS of other cereal, vegetable and fruit crops grown in the cotton-based systems. Through season long FFS on cotton crop, farmers are partially benefiting whereas, similar learning for other crop enterprises from system perspectives could manifestly contribute towards the economic prosperity of the farmers. This is why programme is now considering moving from cotton-IPM to system IPM. One such instance is that FTOF trainees of the Bhawalpur, Punjab established 7 FFS schools on wheat crop IPM, which is mainly followed after cotton. Refreshers courses are under consideration to up-grade the skills of facilitators from merely cotton to other cereal, vegetable and fruit crops of the area. The planned refresher courses would enrich the cotton IPM facilitators to train farmers on complete cropping systems. This important skill enhancement activity planned to be carried out by the National IPM Programme in an organized way. The additional resources would be used to upgrade the skills of core team of facilitators as well as to expand their number for rapid coverage of many crop activities from system perspective.

Farmer Science

The main focus in FFS-based IPM approach is to empower farmers in making appropriate decisions for improved crop management. Deliberate efforts are made to help farmers in the identification of critical crop management issues, design

experiments and analyze data for drawing important conclusions. Farmers perform experimentation during FFS training with the help of facilitators to improve their knowledge base for independent decision-making. Farmers are expected to continue this experimentation during post FFS seasons to improve knowledge base and to evolve technological packages suitable under local conditions. This experimentation would be carried out either as group or individual farmers actions.

The sustainability of the programme components hang around strengthening experimentation by farmers during and post FFS scenarios. FFS-farmers were organized as alumni groups to strengthen farmers-led experimentation. The prime consideration in this activity was to keep communities intact on refining skills learned and generate technological components/packages best suited to their local circumstances. National IPM Programme would strengthen linkages between FFS graduate farmers and research systems to ensure authenticity of the scientific discoveries from farmers

Impact Assessment and quality FFS monitoring systems

Pre-FFS and Post-FFS surveys were conducted on pre-determined IPM-impact indicators that include income, environment, health, knowledge, organization, social justice, and institutional and policy reforms. The post-FFS survey of the

graduate farmers of the 2002 cotton season is accomplished during 2003 cotton season. This quick assessment just after a season long FFS would provide short-term conclusions for making appropriate adjustments in further programme implementations. The long-term impacts will be generated during due course of sustainable programme implementations with revised strategies and improvements in annual programme planning meetings. The new community IPM and farmers to farmers education concepts, experimented recently in the TOF and FFS processes, would require special focuses in future impact analyses, for separately measuring programme outcomes in these vital direction. The case studies to highlight the programme outcome for strengthening farmers' science, conducting mix male and female FFS, farmers led IPM, organizing participatory community development and joint quality/ organic production and marketing of food and fiber crops would be other important areas of impact analyses. National IPM Programme will be performing all these impact evaluation functions in relation to future IPM programme implementation in different regions, provinces, and districts on commodity or system principles. The programme conceived and developed a model for effective monitoring and backstopping of FFS, F2FS and Alumni FFS group activities. It was practiced successfully during 2003 and it helped improving farmer education manifold. District level quality assurance monitoring is indispensable for sustainability, which is also a new approach for the provinces and newly devolved district governments. National IPM Programme will be providing technical backstopping in this important area for ensuring quality FFS establishment mechanisms.

Advocacy at Grass Root and Policy Levels

Neighboring communities of FFS villages are invited to share experiences with the FFS farmers during FFS season long implementations. This generates interest among neighboring communities to adopt/participate in FFS. Awareness workshops, seminars, field visits and study tours for policy makers to promote awareness at decision making levels to support and sustain farmer education in IPM have proved very important experience in Pakistan. National IPM Programme would be continuously interacting with stakeholders at policy and planning levels to provide update on IPM programme accomplishments and convince them for appropriate policy and institutional reforms. The successful implementation of programme at grass root level would require favorable policies from government, appropriate regulatory mechanisms, incentives/disincentives for quality production and establishment of proper market mechanism for quality products.

To sum up the discussion, IPM is now considered as one of the most appropriate approaches to provide a sound transfer of knowledge system in the country's agriculture once it is used as an entry point to transfer crop protection technologies. The future trends as apposed to past, appear to be: i) a holistic IPM based on systems approach, ii) a large scale field implementation focusing on farmer empowerment through Farmer Field School Approach, iii) a strong commitment from Government for IPM as a strategic option to rationalize use of pesticides, iv) Increased consciousness on the part of the consumers about toxic affects of pesticides on Society's health and environment with a resultant enabling environment for IPM, v) a continued "negative expansionist marketing and dumping of pesticide" attitude of agro-chemical industry due to tighter and stricter control in the developed countries, vi) attraction of GMO's appearing as a silver bullet syndrome, and vii) trade and globalization increasingly playing a role in the liberalization of pesticide market.

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Integrated Pest Management

Experiences in pakistan

Abstract

Research and development on IPM was initiated in Pakistan in the 70's. However, efforts to implement IPM at the farm level did not bear fruit. A major obstacle has been the mindset at the policy level to increase crop production to feed the ever-increasing population. Pesticides became a major instrument of increasing production leading to 'pesticide treadmill' situation. Although IPM-FFS "Vehari Model" clearly demonstrated that IPM could be implemented on a large scale at the farm level, a positive enabling environment did not exist. An analysis of pesticide policy through a UNDP-FAO Policy Reform Project paved the way for the establishment of a National IPM Programme and provided instruments to scale up the Farmer-led IPM through integration of international and national efforts on various fronts. The Policy Study has shown that Pakistan's laissez-faire approach to pesticide policy has imposed substantial costs on the national economy that have fallen most heavily on the poorest of the poor segments of the society. The pesticide dependence has given rise to costly negative externalities in the form of damage to human health, to agricultural production systems and to the environment. The study has underscored the need to remove incentives for pesticide overuse, create new incentives for farmers to develop skills in sustainable crop production including pest management, provide unbiased science based information on pesticides and IPM and strictly enforce clear and consistent pesticide rules and regulations. There is a paradigm shift

in the Government thinking leading to efforts on reforming the Pesticide Act and rules, taking in to consideration the health and environmental concerns and international agreements, and adopting IPM as a strategic option to reduce pesticide use. Thus IPM has been institutionalised through the establishment of a National IPM Programme. IPM is now considered as one of the most appropriate approaches to provide a sound transfer of knowledge system in the country's agriculture once it is used as an entry point to transfer crop protection technologies. The future trends as apposed to past, appear to be: i) a holistic IPM based on systems approach, ii) a large scale field implementation focusing on farmer empowerment through Farmer Field School Approach, iii) a strong commitment from Government for IPM as a strategic option to rationalize use of pesticides, iv) increased consciousness on the part of the consumers about toxic affects of pesticides on Society's health and environment with a resultant enabling environment for IPM, v) a continued "negative expansionist marketing and dumping of pesticide" attitude of agro-chemical industry due to tighter and stricter control in the developed countries, vi) attraction of GMO's appearing as a silver bullet syndrome, and vii) trade and globalisation increasingly playing a role in the liberalization of pesticide market.

Introduction

Pesticides use, in Pakistan, began in the fifties, but surprisingly the rules and regulations were formulated and approved much later in 1971 and 1973. Until 1980 the pesticides were subsidized and Plant Protection Department was responsible for pesticide import and their distribution in the country through national agricultural extension network. In 1980, the pesticide business was transferred to private sector, following which a considerable increase in pesticide use occurred over the years (Ahmad et al, 2002); from 665 metric tons in 1980 to 69897 metric tons in 2002, without significant gains in the yield of crops such as cotton, which consumes about 54% of the total pesticides used. However, there is 85% reduction in real value from base year, 1980. Per unit price of pesticides also decreased drastically since 1993 after the introduction of generics. The role of private sector in promoting the production and use of pesticides was found to be tremendous. The private sector also took full advantage of government's pesticide oriented policies (Khan et al, 2002).

The increase in use of pesticides not only drains the exchequer, but also presents a growing threat to the people and environment of the country. Increased pesticide use has created growing resistance among pests and destroyed natural predators. Unplanned use of chemicals resulted in environmental pollution and un-economical returns on the costly investments. The pressure to maximize outputs is enormous on low income and resource poor small farms. They have, therefore, little regard for degradation of natural resources, health risks and future productivity. On the other hand, roughly, 85 to 90 percent of pesticides applied in agriculture never reach the target organism; instead they become

dispersed through the air, water and soil. There is an ecological principle that the poison we put into the environment comes right back to us in our air, water and food. A depleted and polluted environment impact the poor by increasing health problems and lowering the productivity of the natural resources off which they often must live (Khan et al, 2002).

Pesticide policy analysis - a vehicle for IPM implementation

In Pakistan, research and development on IPM was initiated in the 70's. However, efforts to implement IPM at the farm level did not bear fruit. Pesticides became a major instrument of increasing production leading to 'pesticide treadmill' situation. Although an IPM-FFS model implemented in 1996 - popularly known as "Vehari Model", clearly demonstrated that IPM could be implemented on a large scale at the farm level, a positive enabling environment did not exist. An analysis of pesticide policy through a UNDP-FAO Policy Reform Project during 2000 (UNDP, 2001) and the initial input from FAO-EU IPM Programme for Cotton in Asia paved the way for the establishment of a National IPM Programme and provided instruments to scale up the Farmer-led IPM through integration of international and national efforts on various fronts (Ahmad, 2003b; Soomro and Ahmad, 2002).

Pesticide policy analysis results shows sharp increase in external costs related to agriculture pesticide use and these costs fallen heavily on the poorer groups of the society. The economic analysis of pesticide use in Pakistan shows a benefit cost ratio of only 0.43 while including external costs of pesticide use to the society and even excluding these costs yielded a benefit cost ratio of 1.14 only. These results raise some doubts whether the current level of pesticide use in cotton or for that matter in other crops is economically justified (Ahmad, 2003b).

The pesticide industry has a very strong influence in the farming community. By reducing dependence on pesticides, IPM would reduce costs of production and could lead to improved rural health. Thus newly established National IPM Programme (Nat-IPM), based at the National Agricultural Research Centre (NARC) - an in-house research establishment of the Pakistan Agriculture Research Council (PARC) – the Apex NARS Research Coordination body of the Ministry of Food, Agriculture and Livestock, would play a crucial role in this direction (Ahmad et al, 2002; Ahmad, 2003a). Given the low capacity of agriculture extension departments to cater a large population of farmers, the National IPM Programme was challenged with a task of reaching 5.0 million farmers in the Country.

Farmer-led national IPM programme accomplishments

Since 2001 Nat-IPM with the technical support of FAO is implementing the following three projects using cotton as an entry crop as largest pesticide

use is in this crop. The experience gained is being extended to other crops moving from commodity to systems approach.

1. FAO-EU IPM Programme for Cotton in Asia: A Regional Project implemented in six countries; Bangladesh, China, India, Pakistan, Philippines and Vietnam.
2. FAO-ADB Technical Assistance for Cotton IPM in Pakistan
3. FAO-AGFUND Project on Pesticide Risk Reduction in Women in Pakistan.

The implementation of FAO-EU Cotton IPM Programme was initiated by organizing two TOF and 20 FFS in Sindh and revival of five old FFS of Vehari Project during 2001 cotton season. During 2002, two more TOF were organized at Mirpur Khas Sindh and Bhawalpur Punjab, while 104 FFS were organized in seven districts of Sindh. The activity was further expanded in 2003 with three more TOF for Field Assistants at D.G. Khan, Lodhran and Vehari in Punjab, a total of 174 FFS were organized in Sindh (130), Punjab (33) and Balochistan (11).

Thus by 2003, the Programme has organized 7 season-long trainings and trained 258 extension staff, researchers, NGO personnel and farmers as facilitators. It also organized 303 FFS and trained 7781 farmers including 156 females in Sindh (Ghotki, Sukkur, Khairpur, Naushehro Feroze, Nawabshah, Sanghar, Mirpur Khas, Hyderabad and Dadu districts), Punjab (Bahawalpur, Lodhran, Vehari and DG Khan) and Balochistan (Khuzdar, Jafferabad, Naseerabad, Sibi, Bolan and Lora Lai). The Programme in contrast to the FAO's residential TOT/FFS model modified it to be non-residential according to the socio-cultural requirement of the participants where the trainees were returning to their homes every evening; the experiment proved to be successful.

FFS results show that by practicing IPM, farmers have reduced pesticide use by 87% while expenditure on fertilizers have reduced by 26.5%. On the average, their yield was up by 10.5%, input expenditure was less by 22.3% and the gross margin was up by 46%. Only a case study of 90 FFS in six districts of Sindh Province during 2002 cotton season showed that FFS trained farmers adopted IPM technology and got higher profit because of low use of pesticides, fertilizers, irrigation water and intercultural practices. On the average, IPM farmers earned Rs. 8,243/- per ha more net profit as compared to their non-adopter colleagues (Soomro et al, 2003a). It is estimated that if we adopt the IPM technology only on cotton acreage throughout the country we may save Rs. 25.7 billion to the national exchequer. Apart from the above visible benefits IPM approach, if widely practiced, the country could overcome a lot of other problems such as environmental pollution, food contamination; accidental deaths & suicides and diseases/ disorders caused by pesticides, disturbance of agro-ecosystems, pest outbreaks and suppressed biodiversity, and more importantly bring about the change in social behavior of our farmer/rural communities (Soomro et al, 2003b).

Sustainable IPM programme establishment goals

FFS-based IPM approach in Pakistan has successfully switched from project to Programme phase and preparing for entering into a movement state. This will lead to empowerment of farming communities at gross root level, network of community organization, and effective linkages between research, extension, development agencies and formation of community organizations. The key element to enter into this desirable phase is to have a highly skilled team of dedicated facilitators. A core team of 20 expert facilitators at national and regional levels is evolved through TOF and FFS implementation processes, involvements of international experts on facilitation skills, evaluation of the use of facilitation skills and exposure of facilitators to cross-cultural and different agro-ecological environments. In the movement phase our focus is to take FFS approach out of merely plant protection and put it into mainstream extension, and further develop FFS into sustainable farmer groups that can continue to generate new knowledge in a self-reliant manner and to undertake several other developmental initiatives.

The Programme has experimented with many concepts to achieve the sustainability and social equity goals. All these concepts are at preliminary phases of testing and evolution to strengthen Programme footing for expanding IPM approach from commodity orientation to system focuses, addressing gender issues, institutionalizing farmer to farmer knowledge/skills transfers, participatory community development, sustainable use of services of IPM facilitators for promoting farmers science and establishing a net work of FFS based community organizations. The validation of new Programme initiative is further explained as under:

Steps Towards Community IPM

The Sindh provincial extension department deputed the services of extension officers for training in TOF for establishing FFS in different regions. However, such cooperation was lacking from Punjab extension during initial Programme implementation phases. In Sindh also a saturation point was reached quickly, as the available manpower resources were greatly exhausted. It was realized at Programme management level that the goals of reaching a critical mass of the cotton growers, both in Sindh and Punjab provinces, are hard to achieve only by banking upon public sector human resources. Farmer-to-Farmer transfer of IPM knowledge and skills was experimented through organizing Farmers TOF and Women Open Schools (WOS). A team of male and female farmers facilitators was trained to achieve cost effective FFS-based IPM programme implementations. The community IPM concept is evolved through programme investments on producing a cadre of male and female farmers facilitators and a network of community organizations.

Community IPM would be a step forward towards sustaining the use of the services of FFS facilitators, development of WOS, TOF and FFS

on self help basis and establishment of network of regional and national level facilitators and farming community organizations. The farmers who graduated during 2003 as trained facilitators from Farmers TOF organized and registered themselves as Farmers Facilitator Organizations (FFO) in Punjab and Sindh provinces. The Women Facilitators trained through Women Open Schools (WOS) registered themselves as Women Agriculture Development Organization (WADO) in Sindh. The facilitators from Farmers Facilitator Organizations (FFO) organized farmer congresses in Bhawalpur (Punjab), Sukkur (Upper Sindh) and Karachi (Lower Sindh) where a network of Community Organizations of Farmers was established at village, tehsil, district, province and national levels. These organizational initiatives by farmers and facilitators were brought forward to promote community IPM on self-help basis and to link them to national and international NGOs for achieving other developmental goals as well. These are fresh initiatives and have the potentiality for developing required technical capability and financial strength with the passage of time. The National IPM Programme will be providing technical support to these young organizations for achieving maturity and sustainability for emerging as a well knitted independent functioning units.

Capacity Building Of National Institutions

In the EU funded IPM programme the manpower of the provincial extension institutions is trained as facilitators. The prospects of the use of this trained manpower by respective provincial and local governments is vital in the institutionalization of IPM-based extension concepts. The Governments at different levels are convinced with the initial achievements of the programme and policies as well as institutional reforms are in process. The federal government has provided some basic resources for 5 years (2.31 million US$) to strengthen FFS-based IPM programme implementation at national levels. Similarly, Punjab government is heading towards establishing its own FFS-based IPM programme. Advocacy of the outcomes of IPM programme implementation in Pakistan and the technical support from Nat-IPM programme to formulate proposal by provincial extension helped in this direction. Similar efforts would be required towards the institutionalization of FFS-based IPM procedures by other provincial and local government systems. These national and regional initiatives on IPM implementation are very important step towards the institutionalization of this approach and the national programme will be providing technical back-up support for sound programme planning and quality implementations.

The provision of expert facilitators and strong follow-up on the use of facilitation skills, during large-scale expansion of IPM programme in provinces or regions, would be the challenges for national IPM programme. Programme implementation at different levels without proper technical know how could go in the wrong direction and hence wrong conclusion could be drawn which would be detrimental for these new programme initiatives. National IPM Programme will be carrying out follow-up workshops on facilitation skills, practicum to upgrade the experimentation skills and participatory planning and appropriate interventions in the FFS and TOF curriculum, and devising new curriculum based on system aspects of crops management. The transition of expertise from National IPM Programme to provincial and local governments would be the end goal of the institutional capacity building at various levels.

Gender Absorption

Pakistani women play a significant role in agriculture with a participation rate of about 43% in a number of on-farm activities (Habib, 1996). Some even help their men to mix and prepare pesticide solutions, but due to certain socio-cultural reasons they could not participate side by side with male farmers in the regular IPM FFS. On the other hand, studies on health hazards of pesticides to women cotton pickers showed that out of 2.6 million pickers 84% got sick because of exposure to pesticides used on cotton crop during on-farm activities (UNDP, 2001). Thus a special pilot project *"Pesticide Risk Reduction for Women in Pakistan"* for awareness of rural women was developed with the support of FAO and Arab Gulf Programme for United Nations Development Organization (AGFUND). Objective of the study was to train rural women on pesticide exposure and risk reduction within their traditional, cultural and socio-economic framework/setup as the Pakistani women would not participate in regular cotton IPM Farmer Field Schools (FFS) like in other participating countries (Ahmad et al, 2003).

The activity was implemented through workshops, women facilitators training (WFT) and women open schools (WOS) conducted on the pattern of IPM TOF/FFS in districts of Khairpur and Sukkur in 2002 and in districts of Khairpur, Sukkur, Naushehro Feroze and Bahawalpur in 2003. Thus a total of 38 women facilitators were trained in WFT and 493 women farm workers were trained in pesticide risk reduction through 14 WOS in 2002 and 19 in 2003 in Sindh (15) and Punjab (4). The WOS were run for one complete growing season where 25-30 women attend 3-4 hour weekly session at a place (either a house, a guest room, a school or in field), work in groups through discovery based learning in the field (Self-monitoring of acute pesticide poisoning) The pilot programme has developed a team of women facilitators and trained rural women who can serve as a lead group in capacity building of local communities. This pilot study helped to explore the role of Pakistani women in agriculture especially cotton farming community that could be utilized for future planning of such trainings on large scale.

The participating women facilitators were encouraged and promoted to interact with male facilitators and farmers apart from female farmers so as to develop a culture of tolerance and working together side by side. This also helped in spreading the message and understanding of IPM within and between the farm families. As a result of WOS activity, a welfare organization named, "Al-Noor Rural Development Organization" was also

formed in Jiskani Village of Khairpur district with the aim to enhance technical skills of rural poor women of the district so that they could earn a living on their own. "Zubeda Vocational Training Centre", named after the facilitator Ms. Zubeda Jiskani, who voluntarily initiated the activity.

After initial training of women facilitators through WOS in Sindh and Punjab, it is emerged to organize a season-long TOF for women. The gender study on women role in decision-making, consultation in decisions making and her role as laborer has strongly highlighted the need to more intensively involve rural women in TOF, FFS and WOS types of trainings. The complementary role of women in crop management, livestock raising, and small scale enterprises (sewing, embroidery etc.) development is further understood during 2003 through initial experimentation. The local government funding to foster IPM related management and developmental projects in Sindh, is a solid outcome towards strong practical linkage establishment between IPM and local institutions. National IPM Programme has to provide a specialized support and technical back up to sustain these women related crop management, rural livelihood and health initiatives.

Institutionalization of Farmers to Farmer Education

Farmers always performed a catalyst role in technology transfers that has been proved through several adoption studies. Generally, large or risk taking farmers are the early adopters and followed by the neighboring farming communities. Training of farmers as facilitators is an effort to institutionalize these informal technology transfer mechanisms. The initial effort shows a great potentiality towards low cost and sustainable transfer of knowledge, skills and technological packages. The farmers as facilitators have proved themselves more responsible, committed and motivated to deliver in an organized manner.

Farmer to farmer education was specifically experimented during 2003 cotton season. Two farmers TOF were organized one for each Sindh and Punjab provinces. The graduate farmers facilitators have organized themselves and prepared a low cost FFS implementation plan for the year 2004. They have also been able to implement the season long wheat FFS in Punjab as follow-up step with last season cotton FFS. Successful running of F2FS by the project in the 2003 has also created great interest among local/ provincial Governments and NGOs and they are positively thinking to induct the farmer-farmer education in their extension system and rural development programmes. These preliminary successes are achieved through technical backup from National IPM Programme in first rigorously train farmers as expert facilitators and to provide technical back-up in conducting FFS and FTOF during coming seasons.

IPM from Commodity to Cropping System Approach

The current EU-FAO IPM programme is specific to cotton crop only. However, the farming communities have shown keen interest to

participate in the FFS of other cereal, vegetable and fruit crops grown in the cotton-based systems. Through season long FFS on cotton crop, farmers are partially benefiting whereas, similar learning for other crop enterprises from system perspectives could manifestly contribute towards the economic prosperity of the farmers. This is why programme is now considering moving from cotton-IPM to system IPM. One such instance is that FTOF trainees of the Bhawalpur, Punjab established 7 FFS schools on wheat crop IPM, which is mainly followed after cotton. Refreshers courses are under consideration to up-grade the skills of facilitators from merely cotton to other cereal, vegetable and fruit crops of the area. The planned refresher courses would enrich the cotton IPM facilitators to train farmers on complete cropping systems. This important skill enhancement activity planned to be carried out by the National IPM Programme in an organized way. The additional resources would be used to upgrade the skills of core team of facilitators as well as to expand their number for rapid coverage of many crop activities from system perspective.

Farmer Science

The main focus in FFS-based IPM approach is to empower farmers in making appropriate decisions for improved crop management. Deliberate efforts are made to help farmers in the identification of critical crop management issues, design

experiments and analyze data for drawing important conclusions. Farmers perform experimentation during FFS training with the help of facilitators to improve their knowledge base for independent decision-making. Farmers are expected to continue this experimentation during post FFS seasons to improve knowledge base and to evolve technological packages suitable under local conditions. This experimentation would be carried out either as group or individual farmers actions.

The sustainability of the programme components hang around strengthening experimentation by farmers during and post FFS scenarios. FFS-farmers were organized as alumni groups to strengthen farmers-led experimentation. The prime consideration in this activity was to keep communities intact on refining skills learned and generate technological components/packages best suited to their local circumstances. National IPM Programme would strengthen linkages between FFS graduate farmers and research systems to ensure authenticity of the scientific discoveries from farmers

Impact Assessment and quality FFS monitoring systems

Pre-FFS and Post-FFS surveys were conducted on pre-determined IPM-impact indicators that include income, environment, health, knowledge, organization, social justice, and institutional and policy reforms. The post-FFS survey of the

graduate farmers of the 2002 cotton season is accomplished during 2003 cotton season. This quick assessment just after a season long FFS would provide short-term conclusions for making appropriate adjustments in further programme implementations. The long-term impacts will be generated during due course of sustainable programme implementations with revised strategies and improvements in annual programme planning meetings. The new community IPM and farmers to farmers education concepts, experimented recently in the TOF and FFS processes, would require special focuses in future impact analyses, for separately measuring programme outcomes in these vital direction. The case studies to highlight the programme outcome for strengthening farmers' science, conducting mix male and female FFS, farmers led IPM, organizing participatory community development and joint quality/ organic production and marketing of food and fiber crops would be other important areas of impact analyses. National IPM Programme will be performing all these impact evaluation functions in relation to future IPM programme implementation in different regions, provinces, and districts on commodity or system principles. The programme conceived and developed a model for effective monitoring and backstopping of FFS, F2FS and Alumni FFS group activities. It was practiced successfully during 2003 and it helped improving farmer education manifold. District level quality assurance monitoring is indispensable for sustainability, which is also a new approach for the provinces and newly devolved district governments. National IPM Programme will be providing technical backstopping in this important area for ensuring quality FFS establishment mechanisms.

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Current status of

TRAPPING PALM WEEVILS AND BEETLES

Abstract

Oryctes rhinoceros is an economically important problem of young oil palm in South East Asia. Trapping adults using 1 trap / 2 ha lowers damage by over 90% within a few weeks and is competitive with insecticide application. *Rhynchophorus palmarum* is a problem in palmito, coconut and oil palm in Central & South America due to direct larval damage & vectoring of red ring nematode. Pheromone trapping in palmito palm lowers damage by 80% over a year and increases yields by 58%. In coconut trapping of R. palmarum lowers damage by > 80% over 1 year. In oil palm trapping R. palmarum at 1 trap / 5 ha lowers R. palmarum populations and associated damage by > 80% in one year. In the Middle East *R. ferrugineus* infestation of date palm is managed by periodic survey, treatment or removal of infested palms and trapping. There is strong evidence that trapping, in combination with spraying decreases infestation by 64% while smaller scale experiments indicate that trapping alone reduces infestation by 71%. Trapping is most efficient for all palm weevils if aggregation pheromone is combined with food and ethyl acetate. Trapping is made difficult by the requirement for replacement of water & food bait in the traps. This paper reports non-repellant additives that extend the effective life of trap food bait from 2 weeks to 7 weeks. The new additives do not evaporate so that in hot whether traps remain attractive up to 7 weeks without addition of water. This paper also describes tests of repellants that reduce captures of *Rhynchophorus palmarum* in pheromone traps by over 50%. These repellants make possible push-pull strategies to improve management of palm weevils. Additional Index Words: *Oryctes rhinoceros, Rhynchophorus ferrugineus, Rhynchophorus palmarum*, pheromone, kairomone.

Trapping of Oryctes rhinoceros in Oil Palm in Malaysia

Commercial oil palm occupies over 4.5 million hectares in Southeast Asia. At ~25 year intervals plantations must be replanted because the height of trees makes harvesting difficult. Replanting generates large volumes of dead palms that, prior to 1990, in Malaysia were routinely burned. In the early 1990's increasing population in the Malaysian peninsula forced a ban on burning and required alternative disposal techniques such as chipping. Since rotting palm trunk is an excellent environment in which *Oryctes rhinoceros* (coconut rhinoceros beetle) breed *Oryctes* populations increased steadily since burning was banned. Adults emerge in areas with an abundance of their preferred host, young palms, to feed on fronds and spears. Damage is most severe during the second and third year after planting (Figure 1).

Severely damaged palms yield almost no bunches during the second and third year while lightly or undamaged palms yield 9-10 kg bunches (Figure 2). To combat *Oryctes rhinoceros* in commercial oil palm is insecticide (usually cypermethrin) application to each palm (144 / Ha) every two

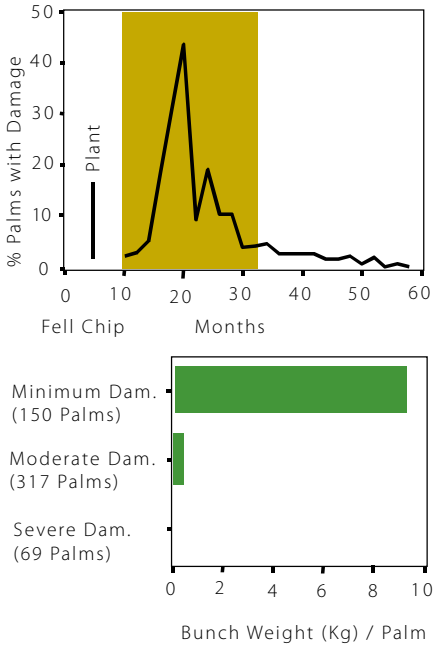


Figure 1. Attack of young palms by O. rhinoceros
Figure 2. Bunch Wt. (kg) in 2 year old palm.

weeks during the susceptible period (Gait Fee Chung, Personal Communication). Although a baculovirus is known for *Oryctes rhinoceros* its operational use has been restricted because of the difficulty of maintaining viable cultures and of dispersion.In the early 1990's the author's research group in Canada identified a male-produced an aggregation pheromone for Oryctes rhinoceros that was highly attractive to male and female beetles (Hallett et al. 1995). Trap and lure optimization led to the selection of a vane trap mounted above the canopy for trapping this insect (Gait Fee Chung, Unpublished). If the vanes protruded into the trap to within 5 cm of the bottom of the trap then beetles that hit the vanes and fell into the trap could not fly out and dry traps could be used to retain captured beetles (Figure 3, Gait Fee Chung, Unpublished)). Trials by Gait Fee Chung of Sime Darby of Malaysia determined that most Oryctes populations could be lowered to below economic thresholds by 1 trap / 2 Ha (Figure 4). Trapping at 1 trap / 2 ha coupled with biweekly servicing makes pheromone trapping of Oryctes rhinoceros less expensive than application of insecticide to 288 plants once every 2 weeks Gait Fee Chung, Personal Communication).

Trapping, in combination with removal of breeding sites, occupies a prominent position in the management of *Oryctes rhinoceros* in Malaysia.

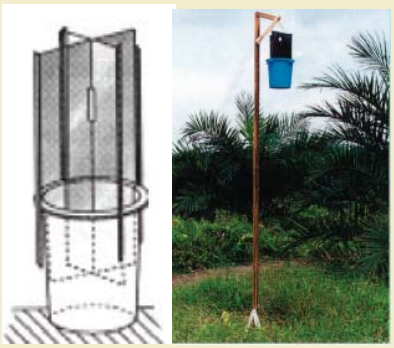
Trapping of Rhynchophorus palmarum and Metamasius hemipterus with the same lure in Palmito Palm in Costa Rica.

The heart of palmito palm (*Bactris gasipaes,* Kunth) is a delicacy in many countries of the world. Increasing demand for dietary fiber continues to fuel demand for palmito heart. Areas dedicated to commercial production in Central and South America in 1996 were about 12,000 Ha of which around 4,000 Ha were in the Atlantic Region of Costa Rica (Anonymous, Min. Agric. & Gran., 1998 Costa Rica).

Palmito palm propagates from offshoots that grow to a harvestable height of one meter in about 3 months. Harvesting discards all parts of the plant except the interior of the stem. In some plantations, competing offshoots are pruned to promote more rapid growth of the remaining offshoots to harvestable size. Harvesting and pruning provide excellent entry points for *Metamasius hemipterus* L. (Vaurie 1966) and *Rhynchophorus palmarum* L. (Couturier et al., 1996; V‡squez et al., 2000). Females of these weevils are attracted to and deposit eggs in cut stem bases. Larvae tunnel the lower stem and rhizome destroying maturing stems.

In the case of *M. hemipterus,* West Indian sugarcane weevil, larvae feed for 30-60 days on the interior stalk before pupating in a fibrous cocoon. Adults live 2-3 months and are good fliers (Vaurie 1966). For *R. palmarum*, the American palm weevil, the life cycle is 70-120 days of which the damaging larval stage is 40-60 days (Giblin-Davis et al. 1989). Male-produced aggregation pheromones for both weevil species are known (Perez et al. 1997; Oehlschlager et al. 1992).

Initial experiments conducted in Costa Rica and Honduras in 1995 led to development of a blend of the two pheromones that allowed trapping of both species in the same trap (Chinchilla et al. 1996). These experiments allowed combination lure trapping of both species in palmito palm (Figure 5 & 6).



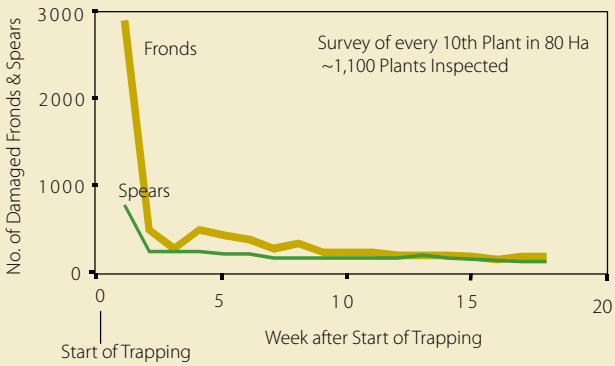


Figure 3. Vane trap for Oryctes rhinoc
Figure 4. Reduction in Oryctes damage 1 Trap / 2 Ha.

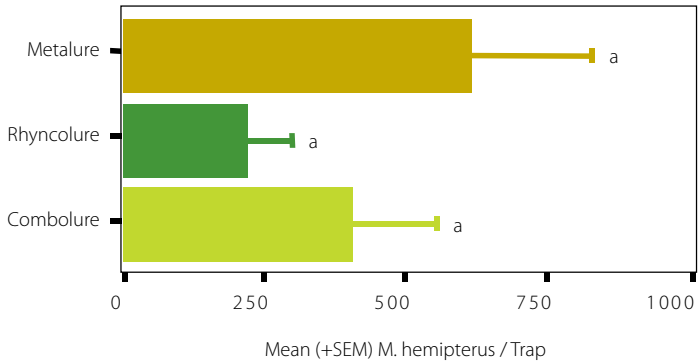


Figure 5. Mean (+SEM) M. hemipterus captured in traps baited with sugarcane and 2-methylhept-5-en-4-ol (Rhyncolure), 4-methyl-5-nonanol : 2-methyl-4-heptanol (8:1, Metalure) or a 1:1 mixture of Rhyncolure and Metalure (Combolure). ANOVA (n = 10) gave F = 4.45, p, 0.566 (NS). Means topped by the same letter are equivalent by Bonferonni t-test (P > 0.95).

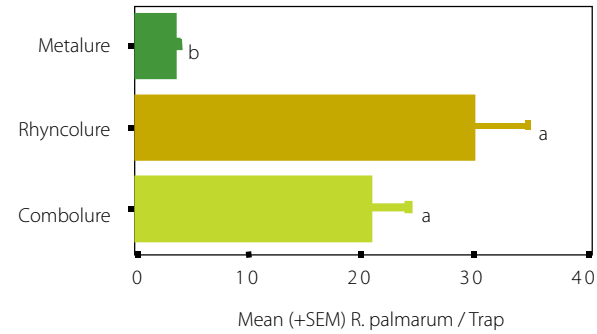


Figure 6. Mean (+SEM) R. palmarum captured in bucket traps baited with sugarcane and 2-methylhept-5-en-4-ol (Rhyncolure), 4-methyl-5-nonanol:2-methyl-4-heptanol (8:1, Metalure) or a 1:1 mixture of Rhyncolure and Metalure (Combolure). ANOVA (n = 12) gave F = 8.50, p < 0.05. Means followed by a different letter are statistically different by Bonferonni t-test (P > 0.95).

Commercial palmito is grown under two regimes, one involves harvesting only (non-pruning) while the other involves pruning mats before during growth to encourage the faster growth of only the strongest stems (pruning). Mass trapping in commercial palmito employing both these growing options was carried out using the combination lure for *M. hemipterus* and *R. palmarum*. Traps were set in two 1 hectare plots (1 pruning and 1 non-pruning) using 4 traps / ha. Each trapping plot was separated from other test plots by at least 100 meters and each test plot was at least 100 meters from any border.

Capture rates of *M. hemipterus* in both pruning and non-pruning plots were similar (Figure 7). *M. hemipterus* capture rates declined from September through December and increased from January through March 1997. The highest capture rates occurred in March-April whereas a second population build-up occurred in September 1997. The first population peak corresponded to the end of the dry season in the Atlantic region of Costa Rica and might be attributed to a higher survival rate of *M. hemipterus* pupae in the dry season due to decreased fungal and bacterial action on pupal cocoons. Mass trapping *M. hemipterus* in banana and plantain in this region previously revealed an increase in capture rates during March-April (Alpizar et al. 1998). The peak in capture rates of *M. hemipterus* observed in September 1997 is attributed to the progeny of weevils that emerged in March-April. Capture rates for *R. palmarum* were much lower than those of *M. hemipterus* at the onset of trapping although after one year of trapping capture rates of both species were similar. Initial capture rates of *R. palmarum* were ~3X higher in the pruned plot than in the non-pruning plot and remained higher for the entire trial. While the capture rates for *M. hemipterus* declined over the trial period capture rates of *R. palmarum* remained rather constant.

Weevil damage decreased and yields increased in trapping plots vs control plots (Figure 8 and 9). Because palmito palm grows to maturity in three months and the time between assessments was five to seven months therefore, each assessment after the commencement of trapping was conducted on palmito stalks grown

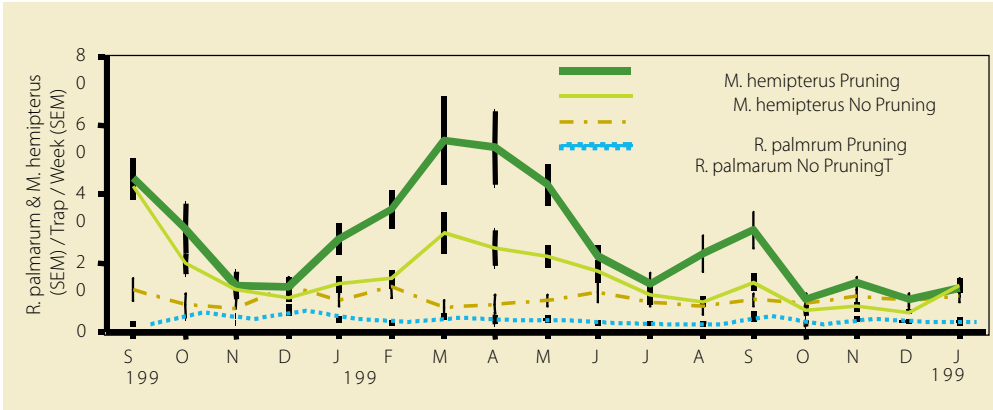


Figure 7. Mean weekly capture of M. hemipterus and R. palmarum in palmito palm. Four traps were placed in one hectare of palmito palm in which pruning was practiced and four traps were placed in one hectare in which pruning was not practiced. Traps were 4 liter plastic containers with windows cut in the sides and baited with combination pheromone lures and insecticide treated sugarcane.

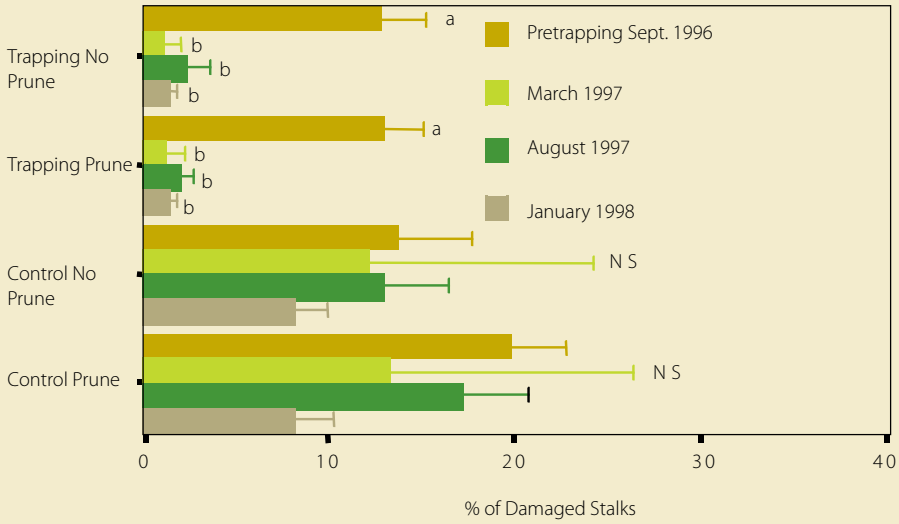


Figure 8. Percent of damaged stalks in palmito palm stalk prior to and after commencement of trapping for M. hemipterus and R. palmarum. Statistical analysis compares each treatment at different dates and does not compare between treatments. Means followed by a different letter are statistically different by Bonferonni t-test (P > 0.95). Damage was determined by examination of all stalks in 60 bunches (mats) of palmito palm within each 1 Ha experimental plot. This was done by cutting all stalks in each bunch at ground level and examination of each stalk for damage. Variables assessed were, total stalks in each bunch, number of stalks in each bunch with larval damage due to M. hemipterus and R. palmarum and number of M. hemipterus or R. palmarum pupae in each stalk.

after the commencement of trapping. The first assessment at month seven revealed weevil damage in trapping plots was reduced by >90% compared to pre-trap levels. This occurred even though considerable numbers of *M. hemipterus* continued to be captured in this time period. We conclude, based upon examination of capture rates and damage data that M. hemipterus and probably *R. palmarum* entering trapping plots after September 1996 chose the traps over palmito stems. A similar phenomenon was noted during trapping Cosmopolites sordidus and *M. hemipterus* in commercial banana (Alpizar et al., 1998).

Yield was assessed on the same dates that damage was assessed (Figure 9). Yields increased dramatically in both trapping and control plots during the trial. After commencement of trapping those plots receiving traps consistently yielded higher numbers of harvestable stems per bunch than control plots without traps.

Trapping R. palmarum in coconut

Trapping of *R. palmarum* in coconut palm is also effective. During 2000-2001 the ChemTica group in Costa Rica conducted trapping of this weevil in 50 ha of coconut palm using traps similar to those used in the Coto and Quepos trials. In the coconut palm plantation in which trapping was conducted direct damage by *R. palmarum* larvae was responsible for palm death. A trap density of 1 trap / ha was used in this trial (Oehlschlager and Gonzalez, 2004 Florida Entomologist, Accepted for Publication). Capture rates of R. palmarum were initially ~11 / trap / week and did not show a significant decline during the 11 month study (Figure 10). This is in contrast to a > 80% decrease R. palmarum capture rates observed in oil palm over 1 year (Oehlschlager et al. 2002).

In the current study infested coconut palms were allowed to act as *R. palmarum* breeding sites. Thus, in the coconut palm trial *R. palmarum*

Figure 9. Harvested stems per bunch prior to and after commencement of trapping for M. hemipterus and R. palmarum (number of stalks harvested from each bunch the week of each damage assessment). Statistical analysis compares each treatment at different dates and does not compare between treatments. Means followed by a different letter are statistically different by Bonferonni t-test (P > 0.95).

Percentage yield increase attributable to trapping was 58% in plots in which pruning was conducted and 70% in plots in which pruning was not conducted. This study has recently been published. (Alpizar et al. 2002).

capture rates remained high throughout the study. Similarly, rather constant R. palmarum capture rates were observed over 26 months of trapping in coconut in Brazil. In the latter case 54 one hundred liter pheromone-sugarcane baited traps were placed around the perimeter of 54 ha of coconut palm infested with *R. palmarum* carrying red ring nematode. Over 97,000 weevils were captured over a 26 month period with no noticeable decrease in capture rate over the entire period (Moura et al. 2000). Despite this the number of RRD infested palms decreased from 206 at the initiation of trapping to 3 within a few months after trapping was started. The most reasonable explanation for a rather constant capture rate accompanied by a declining infestation rate is that weevils immigrating into the plantation as well as those escaping from infested palms preferred traps rather than palms. A similar behavior has been noted in mass trapping of Cosmopolites sordidus, the banana corm weevil. In 1 ha plots, using 4 traps / ha capture rates remain high for >8 months while infestations due to this weevil decrease significantly after <5 months (Alpizar et al. 2000). Immediately before commencement of mass trapping in coconut palm a survey of palms was conducted in the mass trapping area. We identified and tagged coconut palms with yellowing fronds and verified which of these were infested with *R. palmarum* by a subsequent survey in June 2000. Of the coconut palms initially identified possessing yellowing fronds 49 were eventually confirmed to have died as a result of *R. palmarum* infestation. During the remaining period of the study 4 additional palms were found to be weevil infested (Figure 11). This is a decrease of > 90% in the reduction of infestation and compares favorably with the decrease in RRD achieved in oil palm by trapping

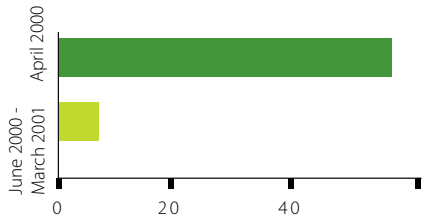


Figure 11. Coconut palms killed by R. palmarum in 50 ha of coconut June 2000 to April 2001 in which trapping was conducted.

R. palmarum at trap densities of 3-7 traps / ha (Oehlschlager et al. 2002).

Trapping R. palmarum in oil palm

Weevils of the genus *Rhynchophorus* are also a major problem in oil palm. In Central and South America *R. palmarum* is a major economic problem. Larvae often kill trees and adults carry red ring nematode that is lethal to palms. Prior to 1993 management of this pest was by systematic inspection of palms coupled with cutting and spraying of cut palms with insecticide. This practice did not control red ring infestation carried by the weevil nor did it control direct weevil damage caused by larvae. In the early 1990's the Oehlschlager group (Costa Rica) developed a trap for *R. palmarum* that employed the male-produced aggregation pheromone and insecticide-laden sugarcane or palm. This group, in collaboration with growers, demonstrated that trapping effectively managed both red ring nematode infection and direct larval damage.

An oil palm plantation of ~ 6,000 ha established near Coto, Costa Rica in the mid 1970's was mature by the late 1980's. Red ring nematode infestation (RRD) was first detected in the Coto oil palm plantation in 1989. In that year 5,171 of ~800,000 palms were diagnosed with RRD. These palms were cut and sprayed with Furadan. During 1990 and 1991 the only measure undertaken to manage RRD was elimination of RRD infected palms. During these years the number of RRD infected palms in the plantation approximately doubled each year. In late 1992, mass trapping of *R. palmarum* in the Coto plantation commenced in sections diagnosed with RRD. Traps are plastic containers tied to palms at chest height and are baited with the male-produced aggregation pheromone and insecticide treated sugarcane or palm pieces (Oehlschlager et al., 1993a, Oehlschlager et al. 2002). Decomposition and desiccation of food bait decreases attraction to traps so food bait

was replaced every 2-3 weeks. Pheromone and kairomone lures are replaced at 3-4 month intervals. While optimum trap densities were not determined, in previous smaller trials (Chinchilla et al. 1993, Oehlschlager et al. 1995) it had been found that a trap density as low as 1 trap / 3.5 ha was sufficient to significantly reduce RRD in a ~ 50 ha stand after a few months (Chinchilla et al. 1993). In the Coto plantation surveys determined that stands with palms older than 17 years were more highly infected with RRD than stands with palms younger than 10 years. Throughout the first year of trapping capture rates in the entire Coto plantation declined from 30 weevils / trap / month to 4 weevils / trap / month, or over 80% (Figure 12). During the period between 1994 and 2001 monthly capture rates were no higher

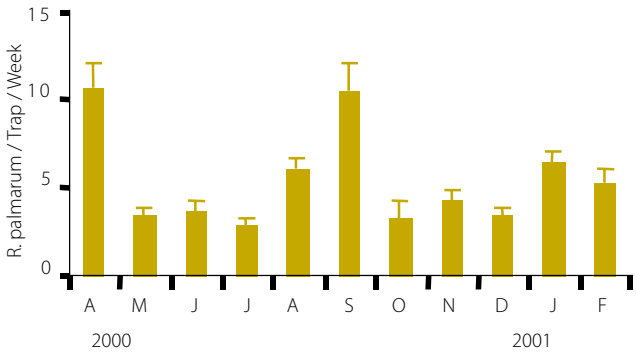


Figure 10. Average of weekly captures (+SEM) of R. palmarum in traps baited with pheromone, sugarcane and ethyl acetate April 2000 to March 2001 in 50 ha coconut.

than 2 weevils / trap / month (Oehlschlager et al. 2002).

To determine if trapping would lead to a faster rate of decrease of RRD infection in stands with high RRD incidence than in stands with low RRD incidence we arbitrarily chose ± 0.5 of a standard deviation of the mean 1992 RRD infection level in the Coto plantation to classify areas in this plantation as possessing either high or low initial RRD infection (Figure 13). The mean 1992 RRD infection level was 3.77 palms / ha and the standard deviation was 4.16. Areas with 1992 RRD infection rates of greater than 5.85 palms / ha were classified as areas of high RRD infection while areas with infection rates less than 1.69 palms / ha were classified as areas of low infection. When classified in this fashion lots in the Coto plantation covering 1,702 ha were classified as possessing high initial RRD infection while lots covering 2,970 ha were classified as having initial low RRD infection.

Capture rates in lots defined with initially high RRD infection were significantly higher for most months of the trial than capture rates in lots defined with initially low RRD infection rate (Figure 14). Lots classified initially with high RRD infection had an average trap density of 1 / 5 ha while lots classified initially with low RRD infection had an average trap density of 1 / 7.7 ha. No matter what the initial RRD, trap density or capture rates, after one year of trapping all areas are reduced to the same low RRD infection rates and *R. palmarum* capture rates.

The effect of trapping on the incidence of RRD

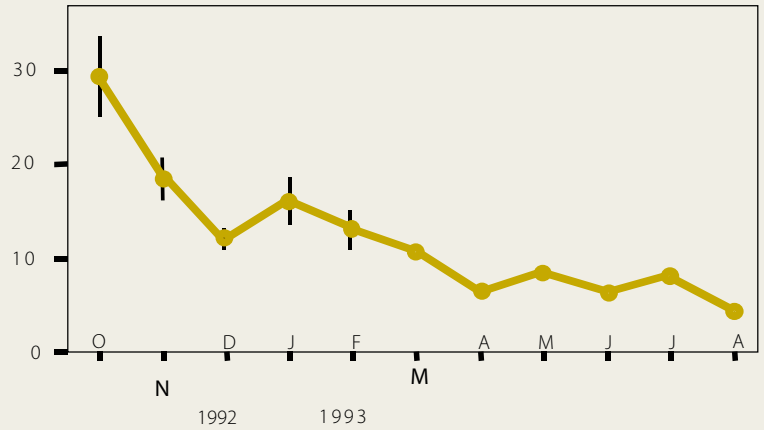


Figure 12. Mean (SEM) capture rates of R. palmarum in all pheromone and sugarcane traps in Coto, Costa Rica oil palm plantation 1992-1993.

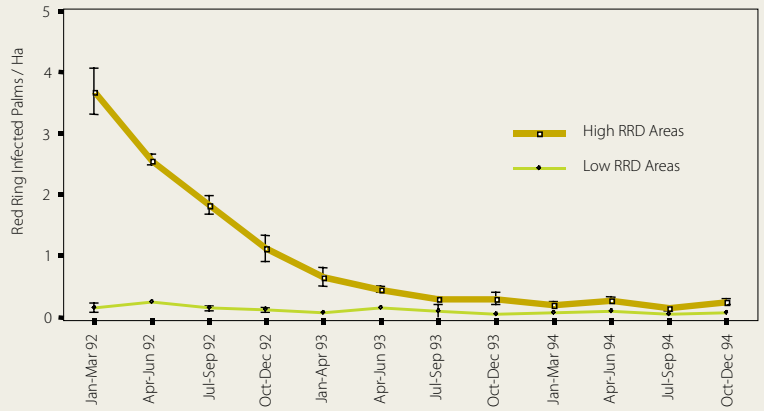


Figure 13. Mean (SEM) RRD infection rates 1992-1994 in areas defined as having high or low RRD in Coto, Costa Rica oil palm plantation. Areas of high RRD had 1992 RRD infection rates > 5.85 palms / ha. Areas of low RRD had a 1992 RRD infection rates < 1.69 palms / ha.

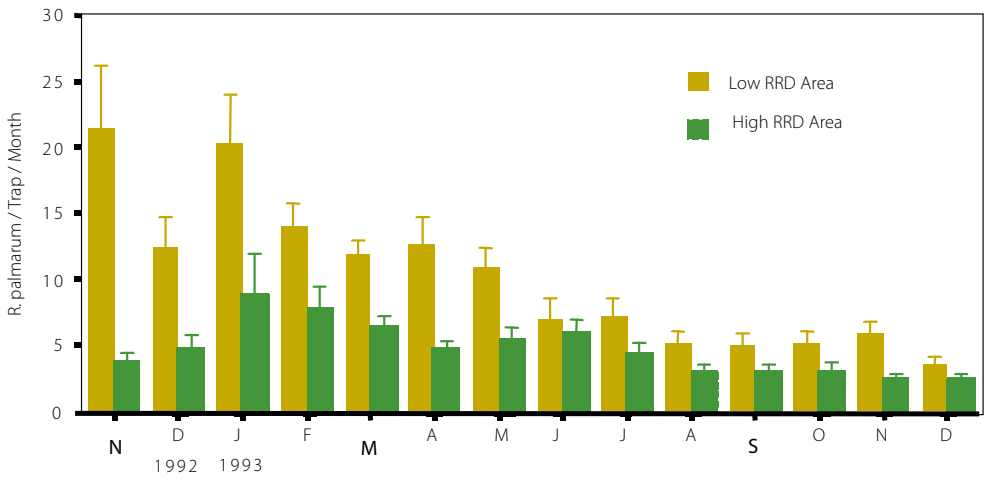


Figure 14. Mean (SEM) capture rate of R. palmarum in pheromone and sugarcane traps 1992-1994 in areas in areas defined as having high or low RRD in 1992 in Coto, Costa Rica oil palm plantation as in Figure 13.

in the plantation is shown in Figure 15. Between 1989 and 1991 RRD management was limited to surveying and eliminating RRD infected palms. In late 1992, traps were introduced throughout the plantation and thereafter RRD incidence level dropped by >90%.

Plantation-wide mass trapping was conducted on 8,719 hectares of commercial oil palm near Quepos, Costa Rica with similar results (Figure 16). Capture rates were initially high but declined to less than 4 weevil / trap / month by 1994. In 2001 the mean capture rate of traps in the Quepos plantation was 1.13 ± 0.16 weevils / trap / month.

In a 3,300 ha oil palm plantation in Honduras trapping *R. palmarum* reduced RRD by 50% in 2 years, 80% in 3 years and 94% in 5 years (ASD, 1999).

Through mark-release-recapture experiments in the Coto plantation in 1991 the initial *R. palmarum* population was estimated at 23-57 weevils per hectare (Chinchilla et al. 1993). During the period April 1991-September 1992 an estimated 123,000 weevils were captured in trap optimization and mass trapping experiments (Oehlschlager et al. 1993b, Chinchilla et al. 1993, Oehlschlager et al. 1995). Plantation-wide mass trapping captured another ~80,000 weevils to the end of 1993. The approximately 200,000 weevils removed by trapping during 1991-1993 corresponds to ~ 30 weevils / hectare. During the same period new RRD infection decreased from ~ 22,000 in 1992 to ~ 5,000 palms in 1993.

Trapping, in combination with removal of nematode infected palms, is the principal method by which weevil vectored red ring nematode is managed in oil palm in Central and South America.

Trapping R. ferrugineus in date palm

Is trapping effective?

Mass trapping of *R. ferrugineus* is widely practiced in the Arabian Peninsula where it is a major problem in date palm. Management of *R. ferrugineus* relies on frequent inspection of palms to detect infestation, treatment of infested palms

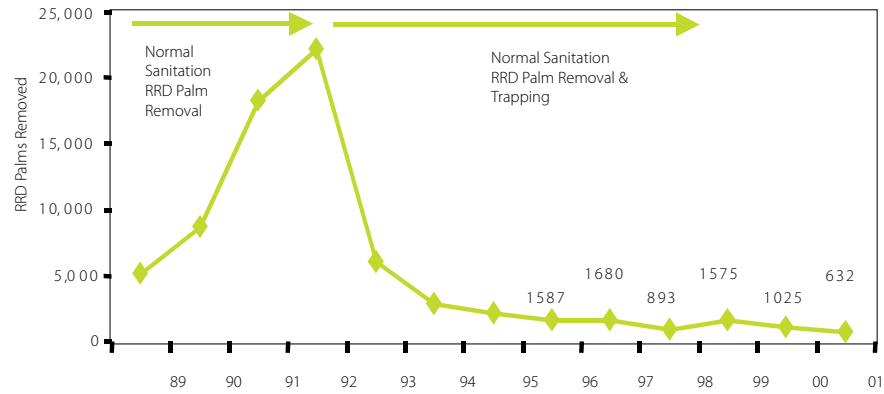


Figure 15. RRD observed in oil palm plantation in Coto, Costa Rica between 1989 and 2001. All palms were inspected bimonthly and infested palms eliminated each year of the study. Pheromone and sugarcane trapping was begun late 1992.

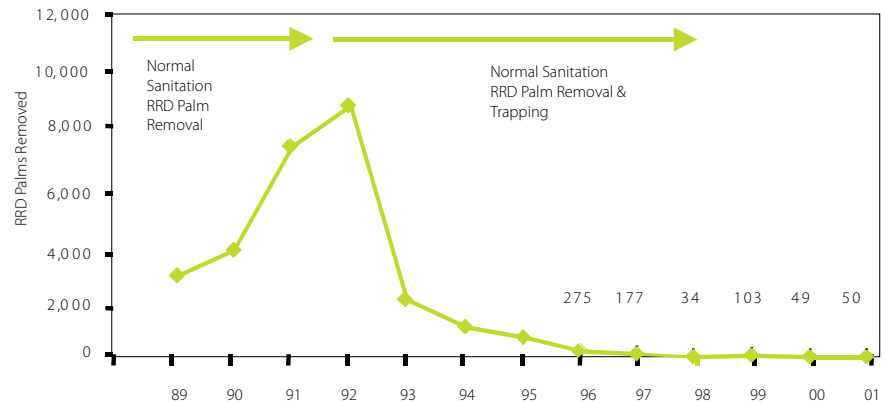


Figure 16. RRD observed in oil palm plantation in Quepos, Costa Rica between 1989 and 2001. Inspection and elimination of infected palms all years. Pheromone and sugarcane trapping was begun late 1992.

by injection of insecticide or removal, periodic spraying and trapping (Abraham et al. 1998).

A major study in the UAE between 1996 and 1998 included 1,466 farms containing > 349,000 palms examined the effect of spraying alone and spraying combined with pheromone trapping. A benefit of ~ 30% less infestation appears to be derived from combined use of spray and pheromone traps compared to spray alone (Figure 17).

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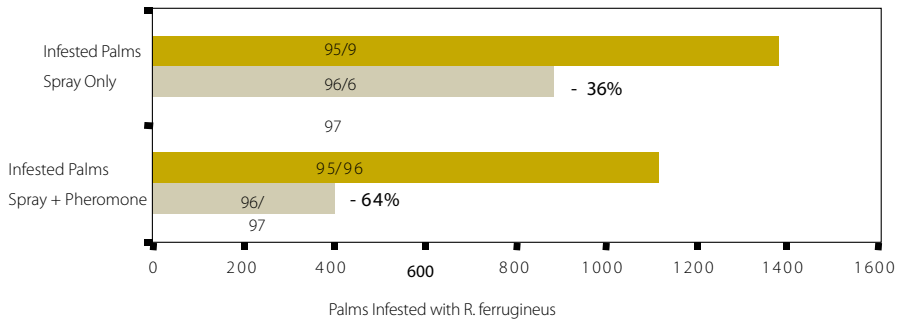
Figure 17. Survey of 1,466 farms in Al-Ain region of UAE between 1994 and 1998. In 1994 farms contained 349,342 palms and had an average infestation rate of 1.9%. In 1995/1996 all farms received chemical treatment and in 1996/1997 45% of the area was treated with chemicals and pheromone traps placed while 55% of the area was treated with chemicals only. In trapping areas in 1996/1997 11,711 weevils were captured. (Ezaby et al., 1998)



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It is often argued that traps attract weevils to an area and that not all weevils enter so traps create a situation in which infestation can increase. In the case of R. palmarum it has been found that although weevils are attracted to areas where traps are placed that infestation goes down in areas with traps (Oehlschlager et al. 1995). The same situation seems to occur in the case of *R. ferrugineus*. Thus in a recent UAE study in which traps were placed on 6 different farms over one year with no spraying the highest captures resulted in the greatest reduction of infestation (Figure 18, Kaakeh et al. 2001). Interestingly, in this study the average reduction in infestation over all 6 farms from one year to the next was 71%. This suggests that trapping *R. ferrugineus* is as effective as trapping *R. palmarum* and that one can expect approximately a 70-80% reduction in infestation over one year if *R. ferrugineus* traps are maintained well and infested palms are treated to prevent further breeding.

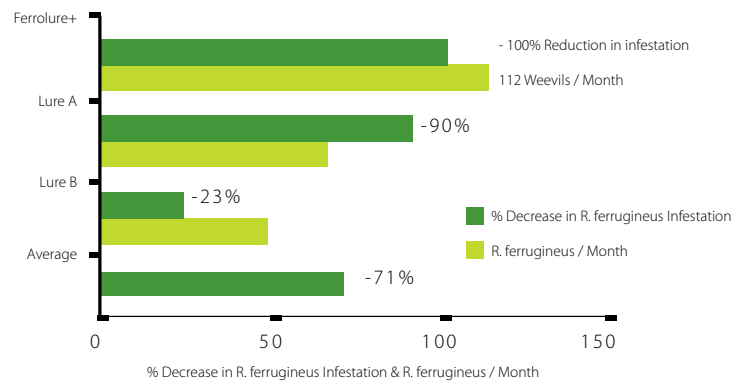

Figure 18. Trapping R. ferrugineus at 6 farms in UAE with 3 different lures. Infestation from first year in which spray only was used to second year in which trapping only was used (Kaakeh et al. 2001).

Trapping of *R. ferrugineus* in date palm over 2 years in India resulted in a 75% decrease in captures suggesting a significant decrease in population (Figure 19, Muralidharan et al. 1999). No damage assessment was made in this study. The decrease in capture rate observed in this study was very

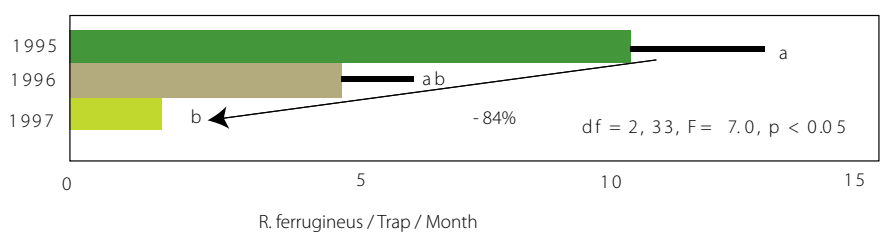

Figure 19. Average capture of R. ferrugineus in 5 date palm gardens in 4 villages in northern India ANOVA (n = 12) gave df = 2, 33, F = 7.0, p < 0.05. Means followed by different letter are significantly different, Bonferonnit t-test, P > 0.95.

similar to the reduction in capture rate observed in Costa Rica for *R. palmarum* trapping in oil palm (Chinchilla et al. 1993, Oehlschlager et al. 2002).

Since female *R. ferrugineus* are the primary target of trapping it is often debated as to whether trapping removes young females with high egg laying potential or old females with low egg laying potential. Dr. Falerio of the Goa, Research Station in India conducted an extensive study of female R. ferrugineus captured in pheromone traps (Falerio, 2000). In his experiment he removed female *R. ferrugineus* daily from traps and placed them alone with only other females or placed them in contact with males also captured in the traps. The captured female *R. ferrugineus* were then allowed to feed and oviposit on sugarcane for the rest of their life. The results indicated that trapped females held separately from males after capture laind an average of 208 eggs during the rest of their life. Since Wattanapongsiri, 1966 reports that wild females lay an average of 127-376 eggs during their lifetime these results indicate that young, gravid females are captured by pheromone traps. Thus, trapping is predicted to have a major effect on egg laying potential of the population.

Palm weevils are present in most plantations in relatively small numbers and have a relatively long life (Wattanapongsiri 1966). These characteristics allow mass trapping to be an efficient management technique since capture of low numbers can significantly impact future populations and a significant proportion of an adult population can be captured over the long period they are susceptible to pheromone and food traps.

Since palm weevils are strong flyers traps can be widely spaced and trapping is expected to be more efficient than spraying for weevil management.

Kairomones in Pheromone Traps:

In the early 1990's it was shown that addition of ethyl acetate to pheromone / sugarcane baited traps increased capture of *R. palmarum* (Jaffe et al. 1993). In 1992 the ChemTica group also determined that ethyl acetate increased by 50-100% the attraction of *R. palmarum* to pheromone traps and spent considerable effort trying to find additional attractants that might further increase attractiveness (Chinchilla, Oehlschlager and Gonzalez, unpublished). Since palm weevils are attracted to wounds of palms that are several days old and fermentation of trap bait food increases attraction it is logical that ethanol might increase capture rates to pheromone / sugarcane baited traps. In 2001 ChemTica examined a report that combination of ethyl acetate and ethanol improves attraction of *R. palmarum* to pheromone / sugarcane traps more than ethyl acetate (Rochat et al. 2000). In several experiments (Figure 10) ethanol did not increase attraction to pheromone / sugarcane baited traps more than ethyl acetate nor did ethanol synergize ethyl acetate. These experiments further confirmed a 50% increase in capture of *R. palmarum* in pheromone / food baited traps that additionally emit ethyl acetate.

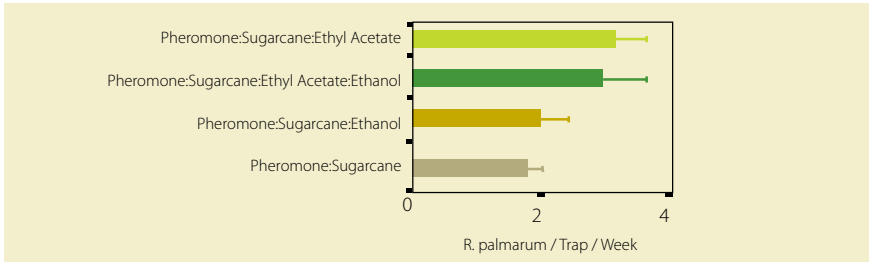

Figure 20. Test conducted May 17-30, 2000 using traps made from 20 liter white plastic buckets with four 5 X 8 cm slots near the top for insect entry. One liter 1% lannate was added to each trap at start of test and 500 mL after the first week. Treatments were fresh sugarcane and ethyl acetate:ethanol lure; fresh sugarcane and ethyl acetate lure; fresh sugarcane and ethanol lure or fresh sugarcane (control). Weevils were counted and removed after first week at which time trap positions rerandomized. ANOVA (n = 20) revealed no significant differences between treatments.

To date the best attractant for *R. palmarum* is the combination of pheromone, food and ethyl acetate (Figure 20).

In July 1997 ethyl acetate was proven increase attraction of *R. ferrugineus* to pheromone traps by 2.6X in the UAE (Anwar and Oehlschlager, CTI Technical Bulletin, 1997 and Oehlschlager, 1998). In August of 1997 addition of ethyl acetate to pheromone traps increased captures by 5X in an Egyptian experiment (Oehlschlager, 1998, Figure 21). In September 1997 ethyl acetate along with several extracts of different palm species and palm tissue were given by CTI to the GCC-AOAD project in the UAE for evaluation. The results of these evaluations suggested that ethyl acetate alone was the preferred kairomone and that no additional attraction was derived from inclusion of palm tissue extract. French workers have published

work (Rochet et al., 2000) that suggested kairomones and pheromone alone were as attractive as food (sugarcane) and pheromone for *R. palmarum*. In Costa Rica the ChemTica group has repeated the French work with much attention to detail and report that the French work is not reproducible and that the blend (best blend H) of kairomones reported is no more attractive to *R. palmarum* than ethyl acetate alone (Oehlschlager and Gonzalez, 2004, Florida Entomologist, Accepted for publication). At the current time the most attractive kairomone for *Rhynchophorus* species is ethyl acetate and its attractiveness has not increased by addition of either natural extracts of palm nor additional synthetic kairomone candidates for either of *R. palmarum* nor *R. ferrugineus*.

Traps loose attractiveness when they become dry. What to do about the problem?

Replacement of food bait due to decomposition and desiccation is a major part of the work of trapping *R. palmarum* and *R. ferrugineus*. In Costa Rica in the dry season food bait becomes dry and unattractive after 2 weeks while in the wet season decomposition renders food bait unattractive due to decomposition after 3-4 weeks. Claims that artifical food bait can be constructed from chemical odors (Rochat et al., 2000) are not borne out by field experiments (Oehlschlager and Gonzalez, 2004 Florida Entomologist, accepted for publication). Water is an essential ingredient of traps since a primary method of retaining weevils in traps is for them to feed on insecticide-laden wet food (*R. palmarum*) or drown (*R. ferrugineus*). In the GCC region food bait in traps often dries out within a few days and traps loose their ability to retain attracted *R. ferrugineus*.

ChemTica conducted several experiments to extend the useful life of trap food bait (*R. palmarum* traps) by addition of inexpensive materials that retard the evaporation of water, are not repellant to the weevils and are not toxic to humans. Figures 22 and 23 show typical results with one such "Trap Extender". The Extender does not evaporate so traps containing it do not get dry. The Extender is not toxic to humans and is relatively inexpensive. The Extender prolongs

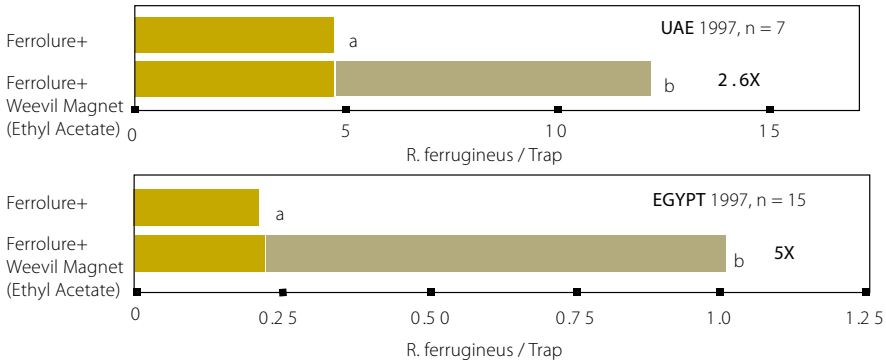

Figure 21. Increase in capture of R. ferrugineus to pheromone / food traps containing lures emitting the kairomone, ethyl acetate. One experiment conducted in UAE (Aswar and Oehlschlager, ChemTica Technical Bulletin) and a second experiment conducted by G. Moawad and Y. El Sebay, PPRI, in Egypt, 1997 (Oehlschlager, 1998). ANOVA on both experiments revealed significant differences between treatments, Bonferonni t-test, P > 0.95.

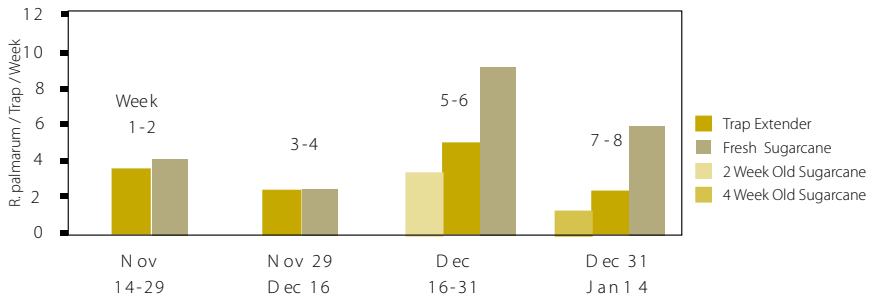

Figure 22. Experiment se1t up November 14, 2000. All traps contained commercial pheromone lures (ChemTica). Treatments were traps baited additionally with fresh sugarcane in 750 mL of water containing 0.13% Lannate (New Sugarcane); 2 week old sugarcane in 750 mL of water containing 0.13% Lannate (2 Week Old Sugarcane); 6 week old sugarcane in 750 mL of water containing 0.13% Lannate (6 Week Old Sugarcane) and fresh sugarcane, ethyl acetate lures in 750 mL of water with 20% Trap Extender and 0.13% Lannate placed November 14, 2000 (Traps with Trap Extender). Ten traps of each treatment were placed. Means of capture are presented. ANOVA on data collected November 29 (n = 9-11), December 16 (n = 9-10) and January 14 (n = 9-10) indicated no significant differences between treatments. ANOVA (n = 8-10) on December 31 and Feb 1 (n = 9-10) indicated traps containing new sugarcane were significantly more attractive than other treatments.

the useful life of sugarcane baited traps until at least 7 weeks. In Figure 22 after 4 weeks traps with the Trap Extender are still more attractive than 2 week old traps with water. Traps with Trap Extender were still attractive and contained liquid after 10 weeks.

In Figure 23 traps prepared with Trap Extender January 14, 2001 remained attractive 7 weeks until March 8, 2001. At this time point traps containing Trap Extender were still almost as attractive as freshly prepared traps.

Can repellants be found to lower palm weevil attack on palms?

A recent study in the UAE and Oman defined the location of attack of *R. ferrugineus* on date palm (Khalifa et al. 2001). As shown in Figure 24 attack is highly

concentrated very near ground level. This is expected since attack often accompanies offshoot removal or damage at ground level. The highly localized nature of *R. ferrugineus*

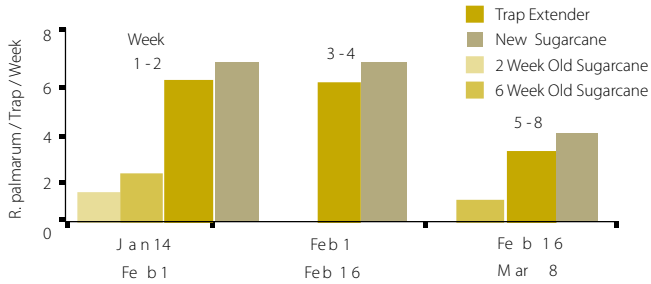

Figure 23. Experiment set up January 14, 2001 all traps contained commercial pheromone lures (ChemTica). Treatments were traps baited additionally with fresh sugarcane in 500 mL of water containing 0.13% Lannate (New Sugarcane), 2 week old sugarcane in 500 mL of water containing 0.13% Lannate (2 Week Old Sugarcane), 6 week old sugarcane in 500 mL of water containing 0.13% Lannate (6 Week Old Sugarcane) and fresh sugarcane, ethyl acetate lures in 750 ml of water with 50% CTI Trap Extender and 0.13% Lannate placed January 14, 2001 (Traps with CTI Trap Extender). Ten traps of each treatment were placed. Means of capture are presented.

attack raises the possibility of using repellants to deter attack on that portion of the palm that is most susceptible to attack. Most repellants deter insects only at close range and then can be expected to function only over short ranges.

Because of the highly localized nature of *R. ferrugineus* attack ChemTica has been investigating repellants for *R. palmarum* with the assumption that this is a good test species for *R. ferrugineus*. The strategy compares capture efficiency of pheromone / food baited traps with pheromone / food baited traps additionally releasing candidate repellants. This approach allows a rapid screening. Rapid screening is necessary because there are over 9,000 compounds reported to be repellant to different insects. ChemTica has narrowed the search by eliminating any compound that has been reported both as a repellant and an attractant and currently has ~ 30 candidates. Repellants are an important strategy for the management of several species of bark beetles. In management of Mountain Pine Beetle (*Dendroctonus ponderosae*) trees are baited with pheromone lures to induce beetles to attack trees in timber stands selected for cutting. Simultaneous baiting of surrounding stands with repellants increases the efficiency of the bait-tree beetle concentration strategy. Similar strategies of push – pull are used for management of the Southern Pine Beetle (*Dendroctonus frontalis*) and the Douglas Fir Beetle (Dendroctonus pseudotsugae).

In trials conducted to date two potent repellants for *R. palmarum* have been discovered. In Figure 25 release of one of these, Repellant A, from highly attractive pheromone / sugarcane / ethyl acetate baited traps decreases capture rates by over 50%. In Figure 16 a similar test of known repellants of other insects is shown. While it could be argued that alpha-pinene would mask the odor of palm trees with that of a non-host pine tree this candidate is not repellant. Likewise, leaf alcohol has been reported to be repellant to many species of insects but is not repellant to R. palmarum.

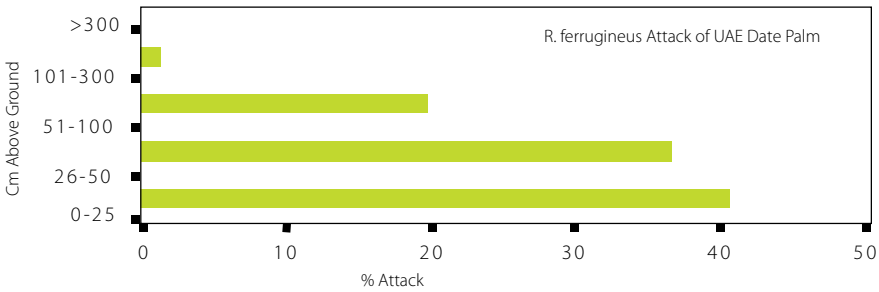

Figure 24. Survey of 1,325,574 Palms in UAE 1998-2000 of which 2,296 were infested. (Khalifa et al, 2001)

Present Status

In Central and South America trapping is well established in the management of problems associated with *R. palmarum*. Current management of *R. palmarum* involves removal of infested palms and trapping. No synergistic combination of pheromone with other biological agents such as Beauvaria bassiana, entomolopathogenic nematodes or viruses has been developed. In the Middle East trapping of *R. ferrugineus* is well established in the management of weevil populations. Trapping is used in combination with regular survey and treatment of infested palms. Biological agents (fungi) are under investigation and show promise. Effective trapping of all palm weevils requires the use of pheromone, food and ethyl acetate. No synthetic chemical combination has been found

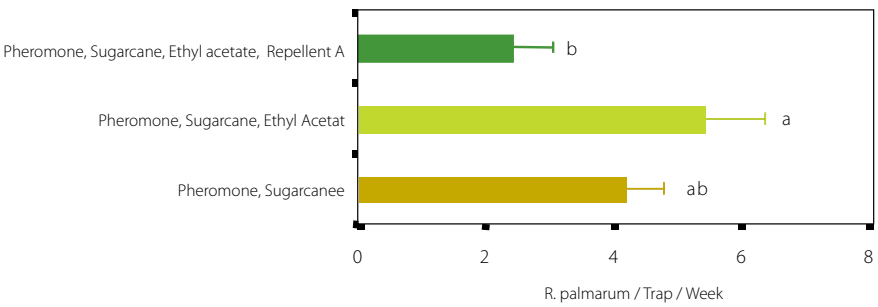

Figure 25. Experiment conducted November 14-29, 2000 in 50 ha of commercial coconut palm in Costa Rica. Treatments were pheromone and sugarcane in 750 mL 0.13% Lannate; pheromone, sugarcane, ethyl acetate with 750 mL water containing 0.13% Lannate and pheromone, sugarcane, ethyl acetate, and Repellant A with 750 mL water containing 0.13% Lannate. ANOVA ($n = 8$-10) gave $p < 0.05$. Means followed by different letter are significantly different by Bonferonni t-test, $P > 0.95$.

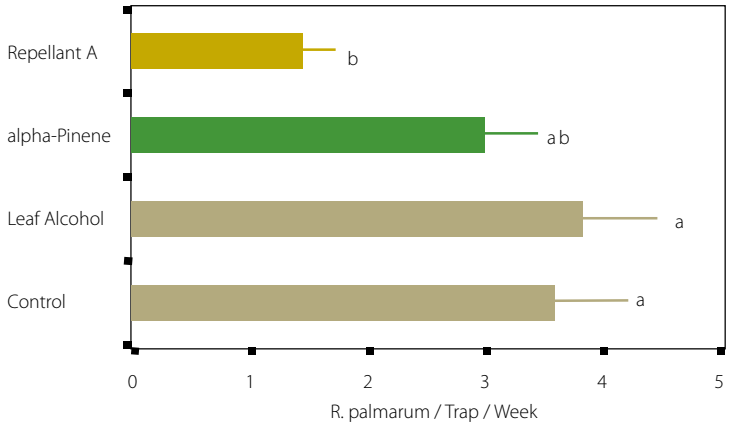

Figure 26. Experiment conducted May 31-June 13, 2000. All traps contained pheromone lures, ethyl acetate:ethanol (1:1) lures and fresh sugarcane immersed in fresh sugarcane 1 liter of 0.25% Lannate. Repellant candidate traps additionally contained slow release devices containing the indicated candidate repellants. Weevils were counted and removed June 6 at which time trap positions were re-randomized. Analysis determined no differences in capture rates on June 6 and June 13 allowing combination of captures for June 6 and 13. ANOVA (n = 17-20), df = 3, 72, F = 4.62. Means followed by different letter are significantly different by Bonferonni t-test, P > 0.95.

to be as effective as natural food as a synergist for any palm weevil pheromone.

Acknowledgements

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حان وقت رد الجميل يا شجرتنا الطيبة
ابو عمر

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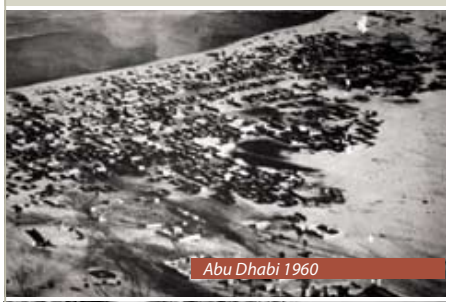
There was a time...

Al Arish architecture in the UAE.


Abu Dhabi 1960


Abu Dhabi Market 1960


Abu Dhabi Berasti Hut 1962


Al Ain House 1962


Liwa, Shah Village 1962

All Pictures courtesy of Al Ain National Museum.

History is a continuous chain of events. The present is only an extension of the past. He who does not know his past cannot make the best of his present and future, for it is from the past that we learn.

We gain experience and we take advantage of the lessons and results (of the past). Then we adopt the best and that which suits our present needs, while avoiding the mistakes made by our fathers and our grandfathers. The new generation should have a proper appreciation of the role played by their forefathers. They should adopt their model, and the supreme ideal of patience, fortitude, hard work and dedication to doing their duty.

Sheikh Zayed

There was a time when people lived closer to nature. The rhythm of work and activities would follow seasons and the shelter materials would come from the land. Today, the modernisation of cities, globalisation and the internet offer less meaning to a specific climate or location. Maybe this is because we can find a technical gimmick to solve every problem, including climate change.

In the search for architectural roots that would be authentic for the UAE, I have come across the richness of the vernacular architecture in its use of palm trees (Al Arish).

Early research produced as a contribution for the Khalifa International Date Palm Award in 2008 concluded, that there is a rich variety of historical building typologies across the UAE created from palm trees. It also proved that there were some differences in the way in which buildings

were designed by the Arish builders in certain Emirates.

Photographs of the period between 1940-1963 demonstrated the adaptability of the palm tree as a building material for constructions with different functions. The creativity of the craftsmanship embraces diverse scales of all applications. In principle the palm tree elements have been used from the city scale to the domestic scale, including Holy Koran book holders. It is a portrait of the origin of architecture based on essential human needs: to find a shelter, to catch the wind for cooling and comfort (the wind tower), to shade a well, to catch fish (gargour), to serve domestic purposes (mats, baskets, trays), to define private boundaries,

to define public boundaries within the city, to trade and to manufacture.

There was a level of experimentation demonstrated by the fathers of the desert and above all great understanding of the palm tree as a building material and its bending properties. Palm sticks were used not only to express rectangular geometry but also curves and arches.

From the analysis of Al Arish applications today, it is possible to see that quite few of these patterns and typologies used in the past, sadly, disappeared from contemporary use.

In response to the need for the preservation of the heritage of Al Arish architecture, there is also a need to use the palm tree as a building material contemporarily in applicable architectural projects, for example in the same way that components from different manufacturers are used in car and aeroplane technologies. A palm tree stick fits perfectly well within the concept of 'component design' – that is using repetitive elements to design a building or a structure.

The Abu Dhabi Authority for Culture and Heritage (ADACH), who commissioned the research aimed at a nationwide review of the Al Arish building typologies, should be commended highly.

It is one of the first major nationwide studies of the UAE heritage, and provides a full and integrated analysis of the history and the present situation. A catalogue of the Al Arish building styles is being produced and it will form the material for the publication of a book.

The Abu Dhabi Authority for Culture and Heritage offer an exemplary approach as regards the preservation of the UAE's cultural heritage and also to the continuity of the UAE's culture.

A small prototypical building has been commissioned to implement a traditional use of

the Al Arish in a contemporary way. The climate change agenda is being addressed in the attempt to use renewable technologies.

We are surrounded today by buzz words such as 'sustainability', 'global networking' or 'green agenda' and a definition of these buzz words is seldom offered.

Having analysed Eco-Worries' recommendations, I personally think that we are called to go back to basics and to revisit the past. We should create architecture that is adaptable and responsive to climatic conditions and basic human needs, with imagination rather than with greed.

The approach to sustainability needs to encompass more than ecological/environmental applications - it is also called to embrace social issues. It is necessary to preserve the local culture of any nation, foster continuity of tradition and protect local identity, whilst using means, aesthetics and technologies of the 21st century.

The champion of cultural, ecological and economic sustainability was Sheikh Zayed who understood the social benefits that would come from the unification of the Emirates. While his vision for the palm tree embraced the agricultural sector, Sheikh Zayed also fostered the preservation of the past and the need to ensure cultural continuity.

In a speech on the occasion of the UAE's first Environment Day in February 1998 Sheikh Zayed spelt out his beliefs:

We cherish our environment because it is an integral part of our country, our history and our heritage. On land and in the sea, our forefathers lived and survived in this environment. They were able to do so only because they recognised the need to conserve it, to take from it only what they needed to live, and to preserve it for succeeding generations.

With God's will, we shall continue to work to protect our environment and our wildlife, as did our forefathers before us. It is a duty: and, if we fail, our children, rightly, will reproach us for squandering an essential part of their inheritance, and of our heritage.

BIOLOGICAL CONTROL OF THE RED PALM WEEVIL

With entomopathogenic nematodes

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Abstract

This work has been carried out in Saudi Arabia through the project of "Transfer of bio-control techniques to management of the red palm weevil in Middle East" a project conducted by "Arab Organization for Agricultural Development" (AOAD). The overall objective of this work was to contribute to the decision makers a program for the biological control of the red palm weevil (RPW) with entomopathogenic nematodes (EPN). This biological control program is ready to be transferred into IPM program of the pest in our Arabic region. The specific objectives were (1) isolation and identification local entomopathogenic nematodes from Saudi Arabia and Qatar, (2) Laboratory evaluation of the nematodes against adults of the RPW, (3) studying the suitability of new nematodes to mass production, (4) semi field evaluation of the nematodes against adults of RPW in date palm trees, and (5) field application of local nematodes against natural population of RPW in date palm farms.

Tow isolates of EPN of genus Steinernema had been discovered. It was the first record of Steinernema from Saudi Arabia and Qatar. Laboratory studies showed that the two new isolates were highly virulent to the RPW. They had high reproductive potential producing 400000-600000 nematodes/Galleria mellonella larva. The studies showed differences between the two isolates in their values of lethal concentration

and lethal time for RPW adults and reproductive potential in G. mellonella larvae. Semi field studies showed high efficiency of the two strains in controlling adults of RPW and recycling in them. In field studies in Qatif, Saudi Arabia: A single spray of a local steinernematid nematode caused reduction in RPW population of 32.47% in date palm farms within one week. However a double spray of a local heterorhabditid nematode -two weeks between sprays- lasted effectively in the field for 4 weeks causing reduction from 31 to 94% in the population of adults of RPW.

Key words: Rhynchophorus, Steinernema, Heterorhabditis, biological control, red palm weevil, entomopathogenic nematodes.

Introduction

The date palm is a holy tree in Arabic region, where every part of it is useful. Arab countries produce two thirds of the world production of dates (6.7 million tons). Egypt being the first country in date production in the world produces over 1.1 million tons followed by Kingdom of Saudi Arabia (830000 tons) and United Arab Emirates (UAE) (760000 tons). Over 55 insect, arthropod or animal pests besides many fungal and bacterial diseases have been recorded on date palm (Al Ahmadi & Salem 1999). The red palm weevil (RPW), Rhynchophorus ferrugineus (Coleoptera: Curculionidae) is the most destructive pest of the date palm in the region since its invasion to UAE coming from the east. It also attacks other palm species like coconut, oil palms and Washingtonia palms. It invaded UAE in1985, Saudi Arabia 1987, Iran 1990, Egypt 1993 (Murphy and Briscoe 1999). It went west to Spain 1994 (Barranco et al 1995), and Italy 2004. All cases of regional and international invasion were through illegal transportation of infested date palm offshoots.

Adults attack palm trees and deposit eggs individually in wounded and soft tissues. The hatched larvae tunnel into the trunk or the terminal bud leading directly to the death of the tree (Griffith 1987, Sivapragasam et al. 1990). Because of the cryptic feeding habit of larvae their control has been difficult. Primary infestations always escape attention and symptoms may not become evident until extensive damage has already occurred (Hanounik et al. 2000). Larval stage lasts 2-3 months with 12 larval instars. The female my lay 370 eggs during its 2-3 month-life. The insect has 4 generations annually (Al Mohanna et al., 2000). OEPP/EPPO (2008) reported that complete life cycle of the weevil from the egg to adult emergence takes an average of 82 days. Males excrete aggregation pheromone that attract both sexes for food, shelter and egg deposition. The chemical composition of the pheromone is: 4-methyl-5-nonanol and 4-methyl-5-nonanon (Sanchez et al., 1996; Faleiro et al., 2003).

Despite intensive efforts and high costs of controlling RPW, the pest is continuously spreading everywhere and destroying the holy tree. Management programs of RPW depend mainly on chemical insecticides (Girgis et al. 2002). Date palm orchards are sprayed periodically with insecticides for protection against the pest. Infested trees usually injected with chemical insecticides. Chemicals go through our sandy soil to ground water and subsequently to all living organisms causing many environmental and health hazards like cancers, kidney failure and liver failure. Biological control with safe measures is aggressively required for management of this pest. Among promising biological control agents are the entomopathogenic nematodes (EPN). EPN of the families Heterorhabditidae and Steinernematidae are commercially produced and used in biological control of many insect pests in the world. These two nematode families are symbiotically associated with bacteria in genera Xenorhabdus (with Steinernematidae) and Photorhabdus (with Heterorhabditidae). The free-living infective juveniles of these nematodes are motile and have chemo-receptors. They are highly virulent, killing their hosts within 24-48 hours, can be mass produced, have highly reproductive potential, have broad host range, are easily applied in the field and are safe to vertebrates, plants, and other non-target organisms. Development of large-scale mass-production technology and easy-to-use formulations led to expanded use of EPN in several countries. Larvae of the wax moth, Galleria mellonella are the most preferred hosts for mass production of many biological control agents because of their high susceptibility, ease and lower cost of culture. Many EPN of families Steinernematidae and Heterorhabditidae are maintained on these larvae in many countries. Indigenous EPN are expected to be suitable for management of local insect pests because of their adaptation to local climate and population regulators.

Local isolates of EPN were recorded for the first time from Arabic Gulf countries (Saleh et al 2001). Among them was Heterorhabditis

indica SA which has been evaluated against larvae and adults of RPW and gave encouraging results in the laboratory and the field (Saleh and Alheji 2003) Elawad et al (2007). Some research works have been carried out in Egypt including pathogenicity of local EPN to RPW in the laboratory (Shamseldean and AbdelGawad 1994; Shamseldean, 2002; Alfazairy et al., 2003; Abdel-Razek et al. 2004) and efficacy of injection of EPN in reducing larval population of RPW in the field (Abbas et al. 2001, Shamseldean and Atwa 2004).

Adults are aggregating mainly in the leaf axils of palm trees for resting, mating and oviposition. They also aggregate at the basal part of the trunk of young date palm trees, near or below the soil level. Leaf axils of date palm being more shaded and humid compared to other external plant parts, are more suitable for the persistence and activity of entomopathogenic nematodes (Hanounik et al. 2000). A considerable portion of 35% of R. ferrugineus infestation in date palm trees in eastern region in Saudi Arabia were found at or below the soil surface where EPN can work very effectively against RPW (unpublished data).

The overall objective of this work was to contribute to the decision makers a program for the biological control of the red palm weevil (RPW) with entomopathogenic nematodes (EPN). This biological control program will be ready to be transferred into IPM program of the pest in our Arabic region. The specific objectives were (1) isolation and identification of two isolates of local entomopathogenic nematodes from Qatar and Saudi Arabia, (2) Laboratory evaluation of the nematodes against adults of the RPW, (3) studying the suitability of new nematodes to mass production, (4) semi field evaluation of the nematodes against adults of RPW in date palm trees, and (5) field application of the nematodes against natural population of RPW in date palm farms.

The Arab Organization for the Agricultural Development (AOAD) - league of Arab Countries – conducted a project (1997-2007) for the biological control of RPW in the Arabian Gulf region, using entomopathogenic nematodes as a major component. There is a long list of publications of AOAD project. This work is a part of un-published achievements of AOAD project.

MATERIAL AND METHODS

Isolation and identification

1 - The Saudi isolate :

A naturally-infected adult of RPW was collected from Ben-Hammam farm in Qatif. The infected weevil was transferred to the laboratory and placed in a White trap (White 1927) for nematode extraction. The extracted nematodes were reared on larvae of the greater wax moth Galleria mellonella according to Woodring and Kaya (1988). Identification of the extracted nematodes to the genus level depended on symptoms appeared on nematode-infected host larvae and the morphology of nematode developmental stages described by Woodring and Kaya (1988), Poinar (1990), and Kaya and Stock (1997).

2 - The Qatar isolate:

Soil samples were collected from a date palm farm in Qatar and transferred to Qatif laboratory in Saudi Arabia where they inspected for the presence of entomopathogenic nematodes. The nematode was isolated from the soil samples using Galleria-bait technique (Bedding and Akhurst 1975) in which larvae of G. mellonella were placed in soil samples and incubated at 25°C for one week then, the infected larvae were transferred to White traps for nematode extraction. Identification of the extracted nematodes to the genus level depended on symptoms appeared on nematode-infected host larvae and the morphology of nematode developmental stages.

Virulence to adults of RPW

Sand barrier bioassay technique (Woodring and Kaya 1988) was used to determine the virulence of the new isolates Steinernema sp SA & Steinernema sp Q to adults of the red palm weevil. The weevils were individually exposed to serial concentrations (treatments) of each nematode (0,500,1000,2000 and 4000 IJ/ml) in 50cc tubes filled with 9 gm fine sand and wetted with 1ml distilled water. Ten replicates were prepared for each treatment. The experiment consisted of 100 units (2 nematode-isolates X 5 concentrations X 10 replicates). Mortality of the weevils was recorded daily. Data were statistically analyzed by plotting regression lines of concentration vs. mortality and values of LC50 were compared.

Suitability for in vivo mass production:

Larvae of G. mellonella were exposed to nematode suspension at concentrations (treatments) of 0, 25, 50, 100, 200, 400 and 800 infective juveniles/ ml/ 5larvae in Petri dishes furnished with filter paper. Each treatment was replicated 4 times. Each experimental unit was represented by a Petri dish contained 5 larvae and 1ml of nematode suspension. Number of experimental units= 2 isolates x 7 treatments x 4 replicates = 56 units. Dishes were kept at 28oC and numbers of alive and dead larvae were recorded daily. Regression lines of mortality vs. concentrations were plotted and values of half lethal concentrations (LC50) were computed. Regression lines of mortality Vs exposure time were plotted and values of half lethal time (LT50) were also computed. The numbers of nematode

offspring migrated from infected G. mellonella larvae for each treatment were recorded and the rates of nematode reproduction were computed for each tested nematode.

Cage studies:

Efficiency of new steinernematid isolates in controlling RPW on date palm trees under cages.

Date palm trees -5 years old- were transferred individually to halves of polyvinyl barrels, 80cm diameter X 80 cm high, filled with sandy soil. Each tree was covered with a 2 meter high plastic screen cage to prevent escape of weevil adults. The cages were arranged out the laboratory building in Qatif. The experiment consisted of 3 treatments (Steinernema sp SA, Steinernema sp Q and control). Each treatment consisted of 4 replicates. Each plot represented by a tree in a cage. A total of 12 plots were used in this experiment. Firstly, the trees were artificially infested with adults of RPW at a rate of 10 weevils/ tree/ cage. After 24 hours, the water suspension of a specified nematode was sprayed on the basal part of the trees and soil around them at a rate of 4 million infective juveniles/ 5 liters / tree. Control plots received only water. The trees and the soil under cages were inspected after 5 and 8 days and numbers of dead and alive weevils were recorded. Dead weevils were transferred to White traps for detecting nematode development and propagation. Insect mortality was calculated for each treatment at specified inspection days. Migration of nematode offspring out infected weevil was the evidence of successful propagation.

Field studies:

Performance of local isolates of EPN in controlling RPW in date palm farms.

Nematodes:

Steinernema sp SA, Heterorhabditis indica HSA

Trapping system:

Pheromone-kairomone terrestrial traps (AOAD traps) described in Hanounik et al (2000) were used for monitoring the adult population of the red palm weevil in treated and untreated date palm farms. The traps were distributed at 100 meters distance between traps (i.e. 1 trap/ hectare).

Experiments:

A date palm farm of approximately 5 hectors was specified for each treatment. The nematode suspension was sprayed in the field using a 600 liter-spraying motor at a rate of 2 million nematodes/ 5 liters/ tree. The spray was directed to the base of palm trees and soil around the trees. Trap catches were recorded weekly in all experimental plots before and after each treatment. The caught weevils were kept individually with food in cups in the laboratory and observed for 3 days and dead weevils were placed in White traps for detecting nematode infections. After field applications dead insects found out of traps or inside treated trees were collected, transferred to the laboratory and inspected for nematode infections.

Statistical analyses:

Population of RPW in studied farms was represented by mean of weevils/trap/week. Means were compared by ANOVA test and SE values were computed and given with their means. Percentages of reduction in the insect population due to different treatments are calculated according the equation of Henderson and Tilton (1955) as follows:

$$R = 100 \times 1 - \left[\frac{Ta \times Cb}{Tb \times Ca} \right]$$

Where: R = Percent of population reduction, Tb = Numbers of insects in treated plots before treatment, Ta = Numbers of insects in treated plots after treatment, Cb = Numbers of insects in control plots before treatment, Ca = Numbers of insects in control plots after treatment.

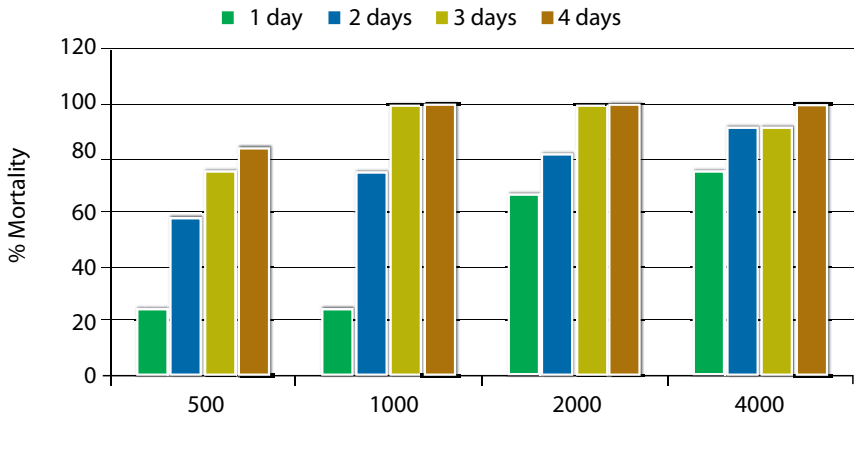

Fig: (1) Mortality in adults of *Rhynchophorus ferrugineus* caused by *Steinernema* sp SA

Results

Isolation and identification

1 - The Saudi isolate :

This nematode was extracted from a naturally-infected RPW adult in Qatif, Eastern Province, Saudi Arabia. The extracted nematodes were reared on larvae of the greater wax moth Galleria mellonella. The nematodes could be identified to the genus level depending on symptoms appeared on infected G. mellonella larvae and the morphology of nematode developmental stages. Evidence certify that the nematode belongs to Steinernema were: (1) the pale yellow color of nematode-infected host larvae, (2) the giant amphemectic females of the first generation found inside host cadavers three days after infection, (3) the identical shape of the tail of steinernematid IJ and (4) the identical appearance of coiled steinernematid IJ. Sample of this new isolate is intended to be sent for identification to the species level by DNA analysis. Until the complete identification, the nematode isolate was given the name Steinernema sp SA. This is the first record of a steinernematid EPN from Saudi Arabia.

2 - The Qatar isolate:

This nematode isolate was extracted from

soil samples from a date palm farm in Qatar. Extracted nematodes were maintained on G. mellonella larvae and identified to the genus level according to symptoms on infected larvae and morphology of developmental stages. Identical morphological characters of steinernematids -mentioned previously- were detected for this isolate. Samples are going to be sent for identification to the species level using DNA analysis. Until the complete identification, the nematode isolate was given the name Steinernema sp Q. This is the first record of a steinernematid EPN from Qatar.

Virulence to adults of RPW

1- Steinernema sp. SA

Data in Fig (1) show that mortality in adults of RPW exposed to serial concentrations of Steinernema sp SA started after 2 days for all used concentrations and reached its maximum (100%) after 4 days for the concentrations 1000 and 2000 IJ/ml and after 5

days for the concentrations 4000 IJ/ml. After 5 days, concentrations above 500 IJ/ml achieved 100% insect mortality. The relative delay in the effect of the highest concentration (4000 IJ/ml) may be due to over-crowding of developing nematodes inside the insect cadaver. From Table (1) a high degree of correlation between the nematode concentration and the insect mortality (R2 = 0.82) was found after 3 days of exposure. The LC50 after three days of exposure was 1373 IJ/ml. Also a high degree of correlation between time of exposure and the insect mortality (R2 = 0.92) was found at the concentration 500 IJ/ml. The LT50 was 1.95 days. This value explained how fast that Steinernema sp. SA can kill the RPW adults.

2 - Steinernema sp Q:

Data in Fig. 2 show that mortality in adults of the red palm weevil exposed to Steinernema sp Q started after 1 day when the concentrations 1000 and 2000 IJ/ml caused 10% RPW mortality. These two medium concentrations caused 100% mortality after 3 days. The lowest and the highest concentrations started their effect and reached their maximum effect one day later. A high degree of correlation between the nematode concentration and the insect mortality (R2 = 0.97) was found (Table 1). The half lethal concentration value (LC50) after 2 days of exposure was as low as 737 IJ/ml/insect. Also a high degree of

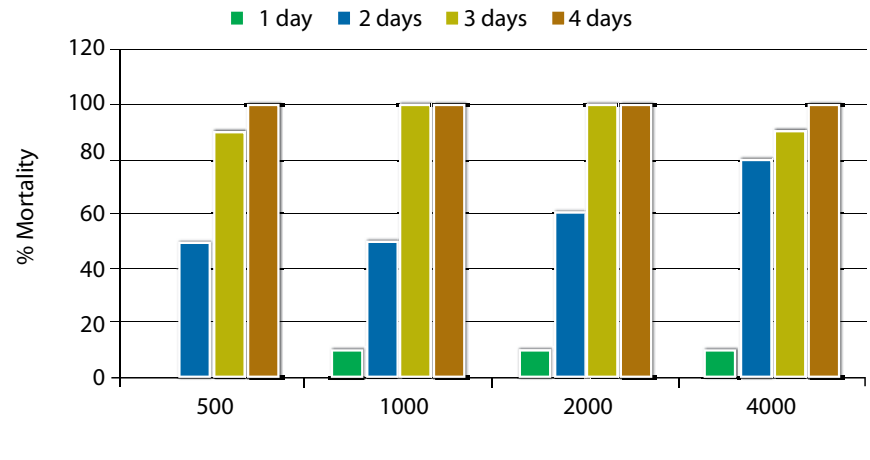

Fig: (2) Mortality in adults of *Rhynchophorus ferrugineus* caused by *Steinernema* sp Q

Nematode	LC_{50} (IJ/ml)	R^2(concentration-mortality)	LT_{50} (days)	R^2(time-mortality)
Steinernema sp SA	1373	0.82	1.95	0.92
Steinernema sp Q	737	0.97	2.2	0.93

Table (1) Statistics of lethal concentration and time of *Steinernema* sp SA and *Steinernema* sp Q against adults of *Rhynchophorus ferrugineus*

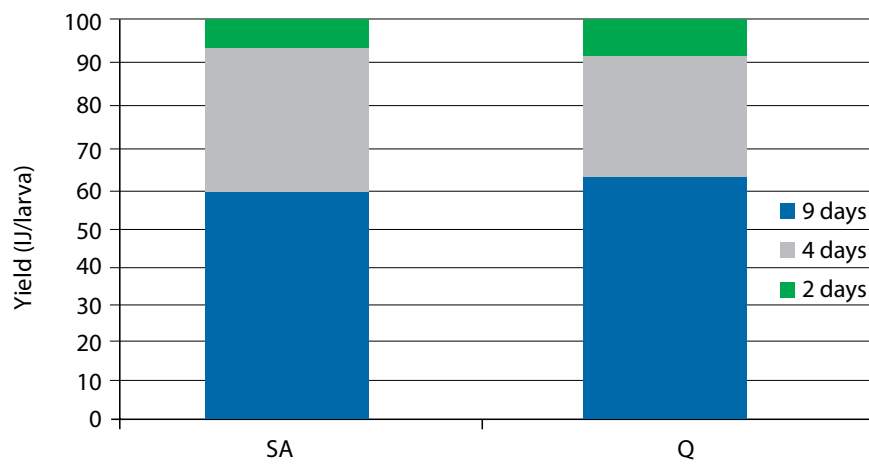

Fig: (3) Distribution of yeild of *Steinernema* sp SA and Steinernema sp Q collected from larvae of *Galleria mellonella*

Inoculum IJ/ml/5larvae	Steinernema sp SA		Steinernema sp Q	
	Yield± SE (IJ/larva)	% larvae producing nematodes	Yield± SE (IJ/larva)	% larvae producing nematodes
25	96875± 46786	55± 9.5	128333± 92071	20± 5.7
50	95625± 34827	50± 12.9	363750± 143837	40± 8.1
100	157300± 46231	90± 5.7	282166± 64638	70± 10
200	282000± 56950	100	495375± 102020	95± 5
400	298300± 10799	100	506375± 222979	95± 5
800	642000± 81425	90± 5.7	246000± 90730	100

Table (2) Reproduction of *Steinernema* sp SA and *Steinernema* sp Q in larvae of *Galleria mellonella* at different inoculum concentrations

correlation between time of exposure and the insect mortality (R2 = 0.93). The half lethal time value (LT50) of the concentration of 500 IJ/ml/ insect was 2.2 days. These results show that both of the new isolates are efficient and fast in killing the adults of the pest with remarkable superiority for the Qatar strain.

Suitability for mass production on *G. mellonella*

1- Steinernema sp SA

Data in Table (2) show that the new steinernematid strains have efficiently reproduced in larvae of G. mellonella. The yield of infective juveniles (IJ) of Steinernema sp SA collected from a single larva reached 642000 nematodes. This yield was obtained when the inoculum concentration was 800 IJ/ml/5larvae. Such a high rate of reproduction may be because the strain still has the power of wildness and still has its high reproductive potential. Lower inoculations resulted in lower yields. Lowest inoculums (25 and 50 IJ/ml/5larvae) produced yields lower than 100000 IJ/larva. Percentages of wax moth larvae produced nematodes have positively correlated with the inoculum concentration. At the concentration 200 IJ/ml/5 larvae or more, Steinernema sp SA successfully reproduced in 100% of host larvae. At concentrations 25-50 IJ/ml/5 larvae, it reproduced in 50-55% of host larvae. From Fig (3) as high as 94 % of the yield of Steinernema sp SA could be collected during the first 4 days after commencement of migration. 56 % of the nematode yield migrated out the host cadavers during the first 2 days. The rest of yield (6%) obtained after 9 days of the commencement of IJ migration. The late nematode yield has always lower quality.

2- Steinernema sp. Q:

From Table (2) Steinernema sp Q gave its maximum yield (506375 IJ/larva) when the inoculum concentration was 400 IJ/ml/5larvae. Unexpectedly the highest inoculum concentration (800 IJ/ml/5larvae) yielded only 246000 IJ/larva. This happened due to probable intra-specific competition resulted from crowded growing nematodes in limited space and food supply. The lowest yield of Steinernema sp Q (128333 IJ/larva) came from the lowest inoculation (25 IJ/ml/5larvae). Percentage of host larvae that produced nematodes correlated positively with the inoculum concentration. At the lowest concentration (25 IJ/ml/5larvae) the nematode reproduced in only 20% of the infected larvae. At a concentration 200 IJ/ml/5larvae or more the nematode successfully reproduced in 95-100% of the host larvae. Fig (3) shows that most of nematode offspring (63 %) migrated out the cadavers of G. mellonella during the first 2 days after commencement of migration. Approximately 90% of the nematode yield could be obtained during the first 4 days after commencement of migration. The rest of nematode yield was collected after 9days of commencement of IJ migration. Inoculation concentrations lower than 200 IJ/ml/5larvae are not advisable for mass rearing on larvae of G. mellonella. The best inoculation concentration is 200-400 IJ/ml/5larvae for the Qatar strain and 800 IJ/ml/5 larvae for the Saudi strain. Over 90% of the yield for both isolates can be harvested during the first four days after commencement of migration out the host cadavers. Waiting for 9 days to obtain less than 10% of the yield is not advisable from economical point of view.

Cage studies:

Efficiency of new steinernematid isolates in controlling RPW on date palm trees under cages

Data in Fig (4) show that both of the new steinernematid isolates (Steinernema sp SA and Steinernema sp Q) were efficient in controlling adults of the red palm weevil under semi-field conditions. Weevil mortality in trees treated with the Qatar isolate, Steinernema sp Q recorded 68.19 % after 5 days of treatment and increased to 93.75% after 8 days of treatment. Weevil mortality due to the Saudi isolate Steinernema sp SA was 84.79 and 97.5% after 5 and 8 days of treatment, respectively. Natural mortality in control cages during the experimental duration was 7.5-10%. Mortality caused by Steinernema sp SA was significantly higher than that caused by Steinernema sp Q after 5 days of treatment. However the difference in mortality caused

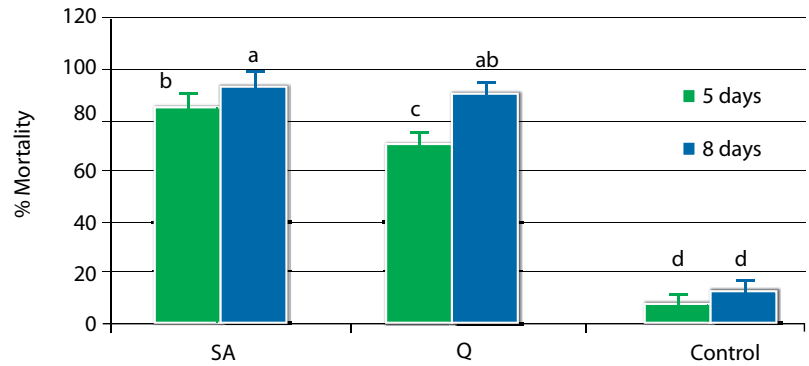

Fig.(4) Mortality in adults of Rhynchophorus ferrugineus in date palm trees under cages after application of Steinernema sp SA and Steinernema sp Q in Qatif, Saudi Arabia. Columns with different letters are significantly different, ANOVA test at P>0.001

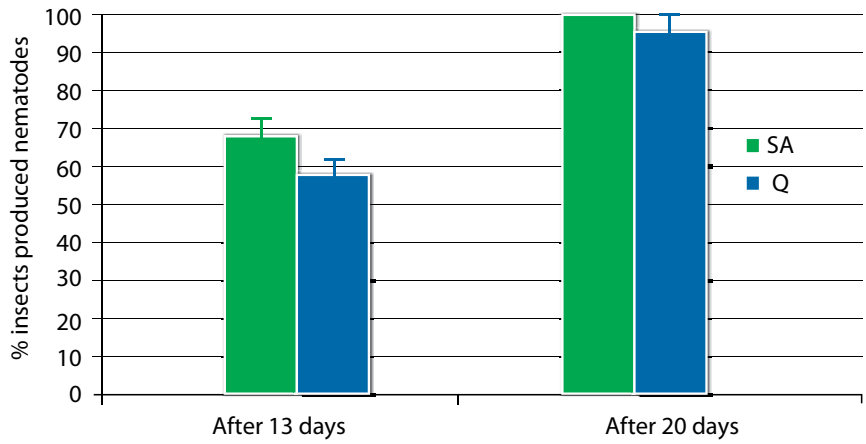

Fig.(5) Propogation of Steinernema sp SA and Steinernema sp Q in adults of Rhynchophorus ferrugineus in date palm trees under cages in Qatif KSA

by both isolates was insignificant after 8 days. Generally, the Saudi isolate gave faster and stronger effect against the pest than the Qatar isolate did. Both of the new nematode isolates were not only efficient in controlling adults of the red palm weevil but also able to propagate in weevil cadavers under semi-field conditions. Propagation of the two isolates in infected weevils differed in speed and level. Percentage weevils produced offspring in case of the Saudi isolate Steinernema sp SA was 66.39% after 13 days of treatment and increased to 100% after 20 days of treatment. In case of the Qatar isolate however, nematode propagation was 57.15% and 94.44% after 13 and 20 of treatment, respectively (Fig 5).

Field studies:

Performance of local isolates of EPN in controlling RPW in date palm farms.

Data in Table (3) show weekly numbers of red palm weevils monitored by pheromone-kairomone traps in date palm farms in Qatif, before and after field application of Steinernema sp SA during April 2007. In the treated farm, a weak Table (3) Population reduction in Rhynchophorus ferrugineus adults after application of Steinernema sp SA in date palm farms in Qatif, Saudi Arabia during April 2007.

ncrease in the pest population from 5.67 to 6 weevils/trap/week has been recorded in the first week after treatment (10-17/4/2007). During the same period, a high increase (from 4 to 6.67 weevils/trap/week) in the natural population of the pest occurred in the control farm. According to Henderson and Tilton's equation a theoretical reduction of 32.87% in the pest population has been registered as a result of Steinernema sp SA application. The effect of this steinernematid isolate was ended in the second week when the traps in treated date palm farm recorded no reduction in the pest population.

In the other field experiment, the local heterorhabditid strain Heterorhabditis indica HSA was sprayed twice – on 27/3/07 and on 10/4/07 – in other date farm in the same region. Table (4) shows the effect of double spray with H. indica HSA against adults of RPW in Qatif date palm farms infested with RPW during April. The effect of the first spray (27/3/07) of this heterorhabditid sustained effectively for two successive weeks. It induced a decrease in the RPW population from 9.66 weevils/trap/week to 5.66 weevils/trap/week in the first week and to 5 weevils/trap/week in the second week of treatment. The natural population during this period was almost stable in the control farm (3.33-3.66 weevils/trap/week). Population reduction as a result of the first spray was 35.5% and 48.27% during the first and the second weeks, respectively. The second spray (10/4/07) with achieved very sharp decrease in RPW population from 5 weevils/trap/week to only 0.33 weevils/trap/week in the first week after application. During this week the natural

Date	Weevils/trap/week ±SE		% Population reduction
	Control	Treated	
10/04/2007	4±0.94	5.67±0.27	
17/04/2007	6.67±0.72	6±0.94	32.47
24/04/2007	3.67±0.27	5.33±0.27	No reduction

Table (3)

Date	Weevils/trap/week ±SE		% Population reduction
	Control	Treated	
27/3/07 (1st treatment)	3.66^{c} ±0.88	9.66^{a}±2.9	
3/4/07	3.33^{c} ±1.76	5.66^{bc}±1.45	35.51
10/4/07 (2nd treatment)	3.66^{c}±1.2	5^{bc} ±2.3	48.27
17/4/07	4.33^{bc}±2.33	0.3 ^{d} ±0.33	97.08
24/4/07	3.66^{c}±0.33	6.66^{b}±1.22	31.03

Table (4) Population reduction in *Rhynchophorus ferrugineus* adults after application of *Heterorhabditis indica* HSA in date palm farms in Qatif, Saudi Arabia during April 2007. Means followed by different letters are significantly different P>0.05, LSD= 2.44

pest population recorded increase from 3.66 to 4.33 weevils/trap/week. The ultimate population reduction obtained until that time was 97.08%. In the second week after the second spray although the pest population recorded an increase in the treated farm, the ultimate effect of the double spray achieved reduction of 31.03% in the pest population. AOVA analysis at P>0.05 showed significant differences between means of weekly trapped weevils in the treated farm before and after treatment for both nematode sprays. The field performance of the heterorhabditid in controlling the pest was better than that of the steinernematid isolate during April. The heterorhabditid sustained effectively in the field for longer time and achieved deeper reduction in the pest population than the steinernematid isolate did. The heterorhabditid nematode looked more tolerant to high temperature in Qatif fields during April than the steinernematid one. High temperatures usually have adverse effects on the activity and persistence of entomopathogenic nematodes. Many references agree that heterorhabditid nematodes are more suitable for high field temperatures than steinernematid ones. These results ensure the importance of choosing the right nematode species and/or strain for field application in a specific environment.

Discussion

The overall objective of this work was to contribute to the decision makers a program for the biological control of the red palm weevil (RPW) with entomopathogenic nematodes (EPN). This biological control program will be ready to be transferred into larger IPM program of the pest in our Arabic region. The specific objectives were (1) isolation and identification of two isolates of local entomopathogenic nematodes from Qatar and Saudi Arabia, (2) Laboratory evaluation of the nematodes against adults of the RPW, (3) studying the suitability of new nematodes to mass production, (4) semi field evaluation of the nematodes against adults of RPW in date palm trees, and (5) field application of the nematodes against natural population of RPW in date palm farms.

In the present work, steinernematid nematodes were isolated for the first time from Saudi Arabia and Qatar. The heterorhabditid H. indica HSA was isolated from Saudi Arabia for the first time by the same author. Qatif Oasis is rich with H. indica HSA so that it could be isolated all the year round from date palm farms (Saleh et al., 2001). Steinernematids are easier for mass production, storage and more preferable to use in moderate temperatures than heterorhabditids. The two nematode genera differ in their life cycles in that the steinernematids contain only amphimictic forms (males and females), whereas the first generation of heterorhabditids (arising from infective juveniles) contain only hermaphrodites (Strauch et al. 1994). They differ in their mutualistic bacteria. Steinernematids are associated with Xenorhabdus spp. and heterorhabditids are associated with Photorhabdus spp. (Poinar 1990).

The present results showed that the two new steinernematid isolates were highly virulent to adults of the RPW. They caused 100% mortality in RPW within 4-5 days using nematode concentration of 500 IJ/ml or more. The two new isolates differed slightly in killing speed, required concentration and rate of reproduction in the pest cadavers. This indicates that they might belong to different species and/or strains. Choosing the right species against a particular pest in a particular environment is very important for successful biological control (Shapiro et al 2002). Some research works have been carried out in Egypt including pathogenicity of local EPN to RPW in the laboratory (Shamseldean and AbdelGawad 1994; Shamseldean, 2002; Alfazairy et al., 2003; Abdel-Razek et al. 2004).

The two isolates were suitable for in vivo mass production in G. mellonella larvae. The Saudi isolate S. carpocapsae SA produced over 600 000 IJ from a single larva. A key factor in the success of EPN as biopesticides is their amenability to mass production (Shapiro and Gaugler 2002). Such a high rate of reproduction may be because the isolates still wild and still have their high reproductive potential. The most common host used for EPN mass production is last instar larvae of G. mellonella because of high susceptibility to most EPN, ease of culture and its ability to produce high yields (Woodring and Kaya 1988). Inoculum concentrations lower than 200 IJ/ml/5larvae are not advisable for mass rearing on larvae of G. mellonella. In vivo production depends on nematode dosage (Boff et al. 2000, Zervos et al. 1991). The best inoculation concentration is 200-400 IJ/ml/5larvae for Steinernema sp Q and 800 IJ/ml/5 larvae for Steinernema sp SA. Over 90% of the yield for both isolates can be harvested during the first four days after commencement of migration out the host cadavers. Waiting for 9 days to obtain less than 10% of the yield is not advisable from economical point of view.

Cage studies showed that both of the new steinernematid isolates were efficient in controlling adults of the red palm weevil under semi-field conditions. The spray was directed to the heart of the tree and soil around it where adults of RPW aggregate. Hanounik et al. 2002 reported that adults of RPW aggregate in leaf axils for mating, feeding and oviposition. Mortality in adults of RPW in date palm trees under cages reached 93.75% and 97.5% after 1 week of a single spray of 2million IJ/5liters/tree of Steinernema

sp Q and Steinernema sp SA, respectively. That was expected result after high virulence shown by both isolates against the adult weevils. H. indica HSA isolated from Qatif achieved 86% mortality in adults of RPW under cages when used with anti-desiccant. The steinernematid nematodes propagated successfully in almost all infected weevils but not in the same time. For Steinernema sp SA for example, it propagated in 66% of infected weevils after 13 days of application and in 100% of infected weevils after 20 days of nematode application. That means that the nematodes do not attack their hosts at the same time. Long field persistence is very important for successful biological control with EPN. Saleh et al 2004 found that S. carpocapsae remained able to kill adults of RPW for 16 days in a date palm farm in Qatif, Saudi Arabia.

Field studies included two experiments. In the first experiment a single spray of Steinernema sp SA was conducted in a date palm farm infested with RPW in Qatif region during April 2007. Under field conditions the steinernematid nematode lasted effectively for one week and caused 32.47% population reduction in RPW adults in the farm. The nematode effect has stopped in the following week. Mean day temperature during April in Qatif is 26.5oC and maximum reaches 35oC. These temperatures seemed unsuitable for longer persistence of the steinernematid isolate in the field. Saleh et al. (2004) recorded active persistence of S. carpocapsae for 16 days in the same region during March. In the second experiment, double spray of 2 weeks separation between them, with H. indica HSA was conducted in the same region and at the same time. These two successive sprays induced population reduction sustained for 4 successive weeks. The first spray persisted actively for two weeks and achieved 35.5 % and 48.27% reduction in the pest population in the two weeks, respectively. Population reduction became 97% and 31% after 1 and 2 weeks of the second spray, respectively. The heterorhabditid isolate sustained effectively in the field for longer time and achieved deeper reduction in the pest population than the steinernematid isolate did. Molyneux (1986) and Grewal et al. (1994) reported that steinernematids were more active at lower temperatures than heterorhabditids of the same origin. The high temperature in Qatif fields during April adversely affected the steinernematid isolate rather than the heterorhabditid one. These results ensure the importance of choosing the right nematode for field application in a specific place and time.

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KHALIFA INTERNATIONAL DATE PALM AWARD

Introduction

The Award was established under the patronage of His Highness Sheikh Khalifa Bin Zayed Al Nahyan, President of UAE (God Protect Him) with a presidential decree, Number 15/2007, dated on 20 March 2007 and on the Presidential Decision Number 02/2007 dated 07 July 2007, which defined the members of the Award's Board of Trustees. His Highness Sheikh Nahayan Mabarak Al Nahayan, Minister of Higher Education and Scientific Research, President of Board of Trustees, attended the Launching Ceremony of the "Khalifa International Date Palm Award" held on April 7, 2008 at Emirates Palace Hotel in Abu Dhabi. The launching ceremony attracted regional and international attention on the date palm tree and the strategic future of dates as a balanced food product, and considering it as an essential part of the sustainable development process initiated that His Highness Sheikh Khalifa Bin Zayed Al Nahyan, President of UAE (God Protect Him).

The Message

The Khalifa International Date palm Award has been created as an appreciation from His Highness Sheikh Khalifa Bin Zayed Al Nahyan, President of UAE (God Protect Him) to the blessed tree and to the people involved in the field of date palm, either in United Arab Emirates or any other country around the world, in order to recognise the outstanding efforts made to develop the date palm for sustainable development for present and coming generations.

The aim of the Award

1. To enhance the prestige of UAE in the field of

date palm research by virtue of its pioneering role in this field.

2. To encourage people involved in the cultivation of date palm: researchers, growers, exporters, whether individuals or agencies.

3. To support research related to the development of the various aspects of the date palm industry.

4. To honor figures engaged in the date palm industry at the local, regional and international levels.

5. To establish and maintain co-operation between the various bodies involved in the date palm industry, particularly in the spheres of production, processing, and marketing, as well as products in which dates constitute a principal ingredient.

6. To disseminate a date palm culture at local, regional and international levels.

7. Nationalization of Knowledge related to date palm through scholarships.

8. Illustrate the various components of the date palm tree as a part of the UAE heritage.

9. Support and encourage new innovations related to date palm industry.

Mission

To encourage people involved in the cultivation of date palm: researchers, growers, exporters, whether individuals or institutions.

To honour figures engaged in the date palm industry at the local, regional, and international levels.

Vision

To enhance the prestige of the UAE in the field of date palm research by virtue of its pioneering role in this field.

To support research related to the development of the various aspects of the date palm industry.

To establish and maintain national, regional and international cooperation between the various bodies involved in the date palm industry, particularly in the spheres of production, processing, and marketing, as well as products in which dates constitute a principal ingredient.

To introduce a date palm culture at local, regional and international levels.

The Scientific Jury

The Scientific Committee consists of eminent scientists and experts in the field who will collectively decide the recipients in each category of the Award.

Each application will be submitted to the corresponding team of assessors. The Khalifa International Date Palm Award assessors will review each submission, individually and collectively. This will be accomplished according to the Award pre-established selection criteria.

1- Prof. Looney Norman

2- Prof. Harrison Hughes

3- Prof. Francis Marty

4- Prof. Abdualla Oihabi

5- Dr. Hassan Shabana

Confidentiality

All information and materials associated with an application for the Khalifa International Date Palm Award will be handled in strict confidence and will not be viewed by any individual or entity not directly involved in the awards process. Furthermore, all jury members and personnel associated with the Award attribution process will sign a non-disclosure agreement ensuring their confidential treatment of all information and all materials involved.

The Prize

The Award shall consist of A trophy carrying the winner's name. A certificate in the winner's name with Award winning category and the date. And A financial reward as follow:

First category: Distinguished Research / Studies

AED 300,000 for the First Winner + a commemorative plaque & Appreciation Certificate.

AED 200,000 for the Second Winner + a commemorative plaque & Appreciation Certificate.

Second Category: Distinguished Producers

AED 300,000 for the First Winner + a commemorative plaque & Appreciation Certificate.

AED 200,000 for the Second Winner + a commemorative plaque & Appreciation Certificate.

Third Category: The Best New Technique

AED 300,000 for the First Winner + a commemorative plaque & Appreciation Certificate.

AED 200,000 for the Second Winner + a commemorative plaque & Appreciation Certificate.

Fourth Category: The Best Development Project

AED 300,000 for the First Winner + a commemorative plaque & Appreciation Certificate.

AED 200,000 for the Second Winner + a commemorative plaque & Appreciation Certificate.

Fifth Category: Distinguished Figure

AED 300,000 for the Winner + a commemorative plaque & Appreciation Certificate.

General conditions:

Applications are accepted from all countries; application can be uploaded through the award website and should be filled in Arabic or English and be sent with a curriculum vitae of the candidate, a photocopy of a valid passport and 3 photographs.

Submit three copies of the original work or the nominated research (one original, one copy and the third electronic soft copy (CD).

Works submitted for the Award shall not be returned to the applicants, they are to be kept in the head office of the Award at Al Ain city.

The Award will be granted to

The award is open to individuals or groups of individuals or institutions or companies or cooperatives or civil society organizations and governmental and private authorities, which have undertaken distinguished works with effective and direct results in the field of date palm. Any organization can nominate itself without any recommendation from any other organization or individual. The award can be granted to any party (individual, company, authority) only once under the same category.

The award

The winner will be granted an appreciation certificate, trophy and financial reward in a luxurious ceremony held in Abu Dhabi.Winners of the Khalifa International date palm award are entitled to use the logo of the award on their advertisement and on marketing materials for a maximum 3 years from receiving the award. Recipients for one of the award's category are able to nominate themselves for the next cycle, but for a different category, Recipients may also apply for consideration in same category after 3 years from winning the award. The winners from different categories of the Khalifa International date palm Award will be appreciated and will be introduced positively through different local and international media channels and in the award magazine and website.

Conditions

The First category (Excellent research and study):

Contributions (research / study) previously awarded any Arab or foreign prize are not eligible.

Works submitted for the award (research / study) should be new, distinguished with direct and effective results in the date palm cultivation and processing fields. It should also be authentic, creative and expanding the knowledge in the date palm cultivation field.

The implementation of the submitted works (research / study) should serve the development of the date palm, with a focus on the market application. The effect of the submitted works should create awareness among society and expand the knowledge in the date palm field.

The (research / study) should be cleared on how the project can be implemented and transferred to other sectors through reflecting the market needs and how easy they can be used.

The second category (Distinguished producers):

The Judging committee should take the following into consideration:

Size of the date palm orchard, production quantity and quality, and the product uniqueness.

Production diversity in regard to produced varieties.

How much modern technical practices are used in the field of drip irrigation, fertilization, protection, thinning, bunch protection and other pre and post harvest techniques.

The Third Category: The Best New Technique:

Similar conditions as applied for the first category will be used.

The new technique must be modern, with a direct effect on the productivity of date palm.

The discovery could be a new date palm clone (a female or a male) with excellent fruits (or pollen) characteristics.

The Fourth Category: The Best Development Project

The proposed development project could be implemented by either the private or government sector or an international organisation.

The project should be characterised by its direct effect on date production and related industries or by - products, or processing and marketing.

The following will also be taken into consideration:

Project work plan and its practical applications

Size of the project and modern applied techniques.

Project production and marketed quantities at both local and international levels.

The Fifth category (Distinguished Figure):

The Scientific committee members should announce the candidates names and the nominated institutions based on the distinguished work undertaken and submitted for consideration. The award can not be awarded to any person, authority, company, twice consecutively.

The Schedule

Application period from 01 June till 30 September, 2009.

The applicants will be informed that their application has been received and forwarded to the judging committee.

Applications that meet the requirements will be informed of their successful application from 01 till 31 October 2009.

The judging committee will start to study and evaluate the applications from 01 November till 31 January, 2010.

The winners names will be announced in the first week of February, 2010 and the honouring ceremony will be held in March, 2010.

For further information, please contact
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الشروط العامة

١- تقبل طلبات الترشيح من كافة أنحاء العالم باللغتين العربية (Simplified Arabic Font) أو الإنجليزية (Times New Roman)
٢- تقديم نسخة من السيرة الذاتية للمرشح مع صورة عن جواز السفر، وثلاث صور شخصية.
٣- لا تمنح الجائزة لعمل سبق له الفوز بجائزة عربية أو أجنبية أخرى .
٤- إرفاق نسختين من العمل أو البحث المرشح (واحدة أصلية ونسخة إلكترونية (CD).
٥- لا تعاد ملفات الترشيح إلى أصحابها سواء فازت أم لم تفز، بل تودع في مقر الأمانة العامة للجائزة بمدينة العين.
٦- يحق للجنة التحكيم حجب الجائزة عن أي فئة إن لم تستوفَ الشروط ودون إبداء الأسباب.

ترسل طلبات الترشيح باسم سعادة أمين عام الجائزة ومقرر مجلس الأمناء على العنوان التالي:

جائزة خليفة الدولية لنخيل التمر:

ص.ب: ٨٢٨٧٢، العين، الإمارات العربية المتحدة.

الهاتف: ٠٠٩٧١٣٧٨٣٢٤٣٤ ، الفاكس: ٠٠٦٧١٣٧٨٣٢٥٥٠

البريد الإلكتروني: kidpa@uaeu.ac.ae

الموقع الإلكتروني: www.kidpa.uaeu.ac.ae www.kidpa.ae

General Conditions

1- Applications should be filled in Arabic (Simplified Arabic Font) or English (Times New Roman)
2- Applications are accepted from all around the world; there are no nationality restrictions.
3- Works submitted for the Awards should be authentic, creative and expanding the knowledge in the date palm cultivation field.
4- Contributions previously awarded any Arab or foreign prize are not eligible.
5- An applicant shall not object to the Award arbitrators' decisions.
6- Works submitted for the Award shall not be returned to the applicants, they are to be kept in the head office of the Award at Al Ain city.
7- Submit two copies of the original work (one original and one electronic soft copy (CD)).
8- It is in the right of supervised attainees to dismiss the Award without stating any reasons.
9- Fill the application form and submit your curriculum vitae detailing the nominee's academic background, experience, previous positions, and listing all published work.

All applications along with due documents are to be sent to:

General Secretariat of Khalifa International Date Palm Award

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