Date Palm Research Center of Excellence
King Faisal University

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Saudi Arabia

Research Program

Sustainable Pest Management in Date Palm (SPMDP)

Duration: Five Years

Funded by: Ministry of Higher Education, and KFU

Starting date: 2015

Research Program

Sustainable Pest Management in Date Palm (SPMDP)

Overview

The date palm, *Phoenix dactylifera* L. is a major crop grown in the Kingdom of Saudi Arabia, which is the third largest date-producing country in the world with an area of 172 thousand ha under cultivation with date palms. In 2001, production was 1.2 million metric tons, which represents 14.96% of the total world production. Several arthropods species have been reported to be pests of date palm inflicting economic damages on the different parts of the tree Including roots, stem, leaves, inflorescence, and fruits both in the field and in storehouses. moth, *Ephestia cautella*, rhinoceros beetle, *Oryctes* spp., and many others. Among those of major economic importance that affect growth and yield of date palms quantitatively and qualitatively are the Red palm weevil, *Rhynchophorus ferrugineus* Olivier, Lesser date moth *Batrachedra amydraula* Meyer and Old world date mite *Oligonychus afrasiaticus* McGregor, date

Scope

Innovative research concept against major pests of date palm will lead to environmentally safe and economically sound IPM.

Great efforts have been exerted during the past years to manage arthropod pests of date palm and to bring their populations below damaging levels. However, the problem is still serious necessitating the improvement of existing control tactics. Solid research is required to accumulate relevant data that can be used to achieve sustainable and environmentally friendly management of these pests.

Damage on date palm trunk by longhorn borer (Cross section)

Vision

SPMDP program is committed to research excellence, innovation, and use of latest technology in the field of date palm pest management

Mission

To serve date palm sector through generation and dissemination of knowledge about date palm pests, and to develop economically feasible, environmentally friendly, and socially acceptable practical solutions.

Research Strategy

The program research strategy emphasizes a problem solving- driven approach

Program objectives

- The program is aiming to carry out multi-disciplinary, innovative basic and applied research on economically important date palm pests in the Kingdom of Saudi Arabia, leading to their sustainable integrated management
- Strengthening collaborative research relationship with relevant national and international programs to leverage our efforts

Research themes and subthemes

a. Biology and ecology of major pests and their biological control

The following subthemes will be addressed:

1. Constructing life-tables for modelling and prediction of the future population dynamics.
2. Identifying tolerance level to major pests in date varieties existing in the Kingdom.
3. Using modern technologies of satellite images (GIS) for locating infested areas and incorporating the data in management programs.
4. Study the effect of intercropping with date palm on the microenvironment and the population dynamic of pests.
5. Survey of Indigenous natural enemies and methods of their populations augmentation or preservation
6. Understanding the semiochemical ecology of

Adult, nymph, and damage of dubas bug on date palm leaf

palm pests

7. Construction of data base on both pests of date palm and their natural enemies

b. Insect biochemistry and molecular biology

1. Chitin Biosynthesis and Inhibition in insects
2. Insecticide Target Enzymes and Molecular Basis of Resistance in RPW
3. Development of RNAi and RNAi-Based Control of RPW
4. Development of RPW Sex-Specific Lethality System
5. Host-Mediated Silencing of Pest Genes (HMSPG)

c. Insecticide screening and resistance management

The responses of insects to pesticides vary between species, strains, or biotypes in the same species. The program addresses the following subthemes:

1. Screening of novel modes of action of chemical classes, as made available.
2. Development of bioassay techniques to monitor and document resistance to existing control agents, Identify potentially effective novel modes of action, and assess pesticide toxicity to key non-targeted organisms.
3. Development of insecticide-resistance management scheme.

d. Pesticides alternatives

Application of pesticides to manage major pest of date palm has become a major concerns and accordingly alternatives that have no or little negative effect on the environment are needed. Therefore, research will tackle botanicals, semiochemicals including pheromone and repellents, and microbial insecticides.

e. Socioeconomics and implementation of IPM

The outcomes or results of research should be socially and economically viable. On-farm trials are one of the ways of information transfer in agriculture domain, which help understanding IPM and encourage interaction with farmers. This theme will address the socio-economic impact of IPM on the date palm growers and the ecosystem

f. Cultural practice

Research is needed to generate information about the relation between the cultural practices of date palm production and pest infestation to formulate successful IPM strategies. Horticultural and cultural practices (e.g. planting space, pruning, removing or keeping suckers, irrigation...etc.) should be investigated to estimate their influence on the infestation by major date palm pests. The

Adult male (left) & female (right), eggs, and larvae of longhorn date palm trunk-borer

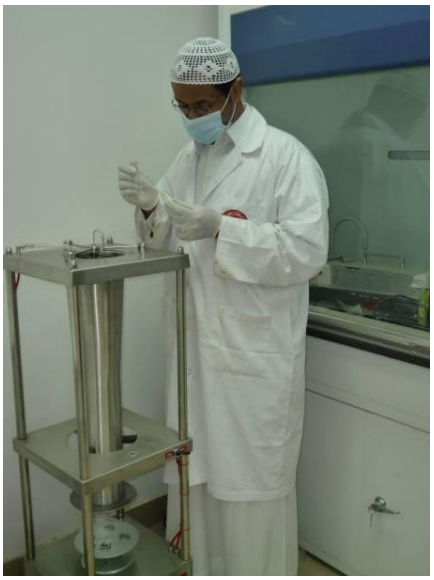
themes will include:
1. Need to study an adoption of cultural methods
2. Review the history of major date palm pest over the past 10 to 20 years.

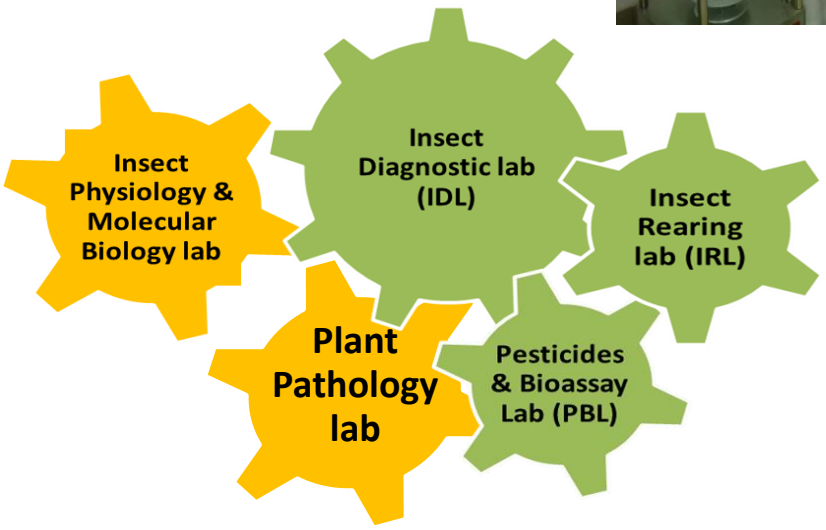
Program components

- Problem-solving research
- Technology transfer
- Post-graduates training and capacity building
- Data base and date palm expert system
- Educational outreach to date palm community and strengthening IPM/FFS (Farmers field schools)
- Recordkeeping and evaluation

Research Infrastructures

We have three modern labs namely insect diagnostic lab, insect rearing lab, and pesticides and bioassay lab as shown in the figure below. We are intending to establish two more labs, insect physiology & molecular biology lab, and plant pathology lab. An insectary and a mesh-house are available to carry out semi-field trials. Our labs are fully integrated with other DPRCE labs and King Faisal University's wider facilities.





Program Organization and Management

The program comprises a set of research projects based on the themes and subthemes of strategic significance. A multidisciplinary research is adopted and improvement and achievement of objectives is approached from a holistic perspective. A high-level advisory committee and project peer review Panel are responsible for the assessment of the projects that are considered in the program.

The Program Research Plan (2015-2019)

The activities of the program will fall into two categories:

1- Area of greater significance

The focus will be on the date palm trunk-borer (LHB), *Jebusaea hammerschmidti* as per the schedule mentioned in the activity chart below.

Sr. No.	Activity	Years 2016-2020				
		1st	2nd	3rd	4th	5th
1	Biology, ecology, and phenology of the beetle	*	*	*	*	*
2	Estimation of economic threshold	*	*	*		
3	Understanding the semiochemical ecology of LHB	*	*	*	*	*
4	Screening date palm cultivars in the Kingdom for resistance to longhorn date palm trunk-borer	*	*			
5	Assessing of date palm farming practices that influence the buildup and infestation of LHB	*	*	*	*	*
6	Area-Wide management of LHB using participatory approach			*	*	*
7	Insecticide bio-assay and Standardizing application procedures	*	*			
8	Survey of the natural enemies of LHB	*	*	*	*	*
9	Optimizing light trapping protocols	*	*			
10	Use of entomopathogenic fungi for the management of LHB	*	*	*	*	*
11	Training for officials and field day for farmers	*	*	*	*	*
12	Organize a regional Workshop on LHB					*
13	Compilation of database on LHB				*	*
14	Estimated budget	**1.2 million SR**				

2- Secondary area of potential significance

The research will focus on the saw-toothed grain beetle, *Oryzaephilus surinamensis* L. as a serious pest of stored dates and the rhinoceros beetles or fruit stalk-borer, *Oryctes* spp. that are emerging as serious pests of date

Team members of the program

Research Staff

Hamadttu, A. F. El-Shafie, Ph.D. Entomologist **(CV. Synopsis)** (Head)
Babiker M. A. Abdel Banat, Ph.D. Insect molecular biology **(CV. Synopsis)**

Technical staff

Ibrahim, A., Bou-Khowh, (B.Sc., Entomology)
Wael Al-Sayed Mohammed Arabi (M.Sc., Molecular biology)

Contact

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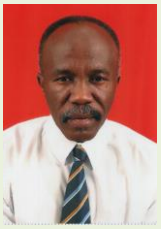
Research staff CV. Synopsis



PERSONAL DATA

Name: Hamadttu Abdel Farag Elshafie
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Date and Place of Birth: Jan. 1962, Gillas (Village in Northern Sudan).
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EDUCATION BACKGROUND

1988: B.Sc. (Agric.) Honors University of Khartoum.
1993: M.Sc. (Agric.) University of Khartoum (Entomology).
2001: Ph.D. in Agriculture, University of Giessen (Germany).

RESEARCH TOPICS AND AREAS OF INTEREST

-Control of insect pests by natural substances and synthetic insecticides acting systemically.
-Promotion of biological pest control and integrated pest management and organic farming.
-Population ecology of epigeal predatory Arthropods, Carabids, Staphylinids and Spiders.
-Management of the red palm weevil *Rhynchophorus ferrugineus* attacking date palms

RECENT PUBLICATIONS

1. El-Shafie, H.A.F. (2015). Biology, Ecology, and Management of the Longhorn Date Palm Stem Borer Jebusaea hammerschmidti (Coleoptera: Cerambycidae). Outlooks on Pest Management 26 (1): 20-23. (DOI: 10.1564/v26_feb_06)
2. M. S. Hoddle, C. D. Hoddle, J. R. Faleiro, **H. A. F. EL-Shafie**, D. R. Jeske and A. A. Sallam, (2015). How Far Can the Red Palm Weevil, Rhynchophorus ferrugineus (Coleoptera: Curculionidae), Fly?: Computerized Flight Mill Studies with Field Captured Weevils. J. Econ. Entomol. 108(6): 2599-2609; DOI: 10.1093/jee/tov240
3. Mozib, M. E., **El-Shafie H. A. F**., and AL-Hajhoj, M. R. (2015). Potentials for early detection of red palm weevil, Rhynchophorus ferrugineus (Olivier)-infested date palm (Phoenix dactylifera (L.)) using temperature differentials. Doi: 10.4039/tce.2015.51
4. Faleiro, J. R., **El-Shafie, H. A. F**., Ajlan, A. M. and Sallam, A. A. 2014. Screening date palm cultivars for resistance to red palm weevil, *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae). Florida Entomologist 97(4): 1529-1536.
5. **El Shafie, H. A. F**.; Faleiro, J. R.; Abo-El-Saad, M. M. and Aleid, S. M. 2013. A meridic diet for laboratory rearing of red palm weevil, *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae). *Scientific Research and Essays, 8(39): 1924-1932.*

PATENT (GC 2014-27894)

Title of invention: A repellent against the red palm weevil, *Rhynchophorus ferrugineus*. The patent is in collaboration with Chem Tica International Company and Date palm research center of excellence, King Faisal University. Patent Office of the Cooperation Council for the Arab States of the Gulf (filed).

Research staff CV. Synopsis

PERSONAL DATA

Name: Babiker M. A. Abdel-Banat, PhD
Date of birth: October 29, 1966
Gender: Male
Marital status: Married (father of three children)
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EDUCATION BACKGROUND

PhD, Insect Biochemistry and Molecular Biology Tottori University – Japan, 2001
M.Sc., Integrated Pest Management University of Khartoum – Sudan, 1996
B.Sc., (Agric) Class one with Honors University of Khartoum – Sudan, 1993

RESEARCH TOPICS AND AREAS OF INTEREST

1. Insect's biochemistry, molecular biology and genomics.
2. Basic and applied molecular biotechnology for environmentally sound energy generation projects (Biofuel Technology).
3. Use of eukaryotic cells for biotechnology amendment to develop tools for biopesticides and cancer research.

RECENT PUBLICATIONS

1. Alhudaib k.a., Rezk a.a., Abdel-Banat B.M.A., Soliman A.M. Molecular identification of the biotype of whitefly (Bemisia tabaci) population inhabiting the eastern region of Saudi Arabia. Journal of Biological Sciences (2015) Online first (DOI: 10.3923/jbs/2015).
2. Hoshida H., Murakami N., Suzuki A., Tamura R., Asakawa J., Abdel-Banat B.M.A., Nonklang S., Nakamura M., Akada R. Non-homologous end joining-mediated functional marker selection for DNA cloning in the yeast Kluyveromyces marxianus. Yeast 31: 29-29 (2014) (DOI: 10.1002/yea.2993).
3. Abdel-Banat B.M.A., Hoshida H., Akada R. Autonomously replicating sequences from Kluyveromyces marxianus apparently without canonical consensus. In the 2014 Yeast Genetics and Molecular Biology Meeting (July 29 – August 3, 2014), University of Washington, Seattle, USA. http://www.genetics-gsa.org/yeast/2014/
4. Abdel-Banat B.M.A., Asakawa J., Hishida H., Akada R. Functional validation of Kluyveromyces marxianus autonomously replicating sequences. In the 2012 Yeast Genetics and Molecular Biology Meeting (July 31 – August 5, 2012), Princeton University, Princeton, New Jersy, USA.
5. Abdel-Banat B.M.A., Kuroki R., Tokuda S., Hoshida H., Akada R. Repair of DNA double strand breaks in Kluyveromyces marxianus generates heterogeneity in chromosomal structure. In the 2012 Yeast Genetics and Molecular Biology Meeting (July 31 – August 5, 2012), Princeton University, Princeton, New Jersy, USA.

PATENTS

1) Patent title: Flocculent yeast and method for production thereof. Patent application numbers in Japan FUJ-H19049, 2008-069329 and 2008-187206; Application number in U.S. PCT/JP2009/001214. Inventors: Akada R., Nonklang S., Hoshida H., Abdel-Banat B.M.A.

2) Patent title: Gene Cloning via non-homologous end joining in the yeast Kluyveromyces marxianus. Patent application number in Japan FUJ-H21048 and 2010-058917. Inventors: Akada R., Abdel-Banat B.M.A., Asakawa J., Hoshida H