The current state of the art research and technologies on RPW management

Hassan Y. Al-Ayedh
Professor of Entomology
Life Science and Environment Research Institute King Abdulaziz City For Science and Technology
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Presentation elements

1. Introduction.
2. Invasion.
3. The Purpose of this study.
4. Methods used.
5. Results.
6. Area heavily worked on and others not?
7. Top Institutes.
8. Top Countries.
9. Examples of Efforts.
10. What is the next step.
11. Conclusion and Recommendations.
Red Date palm weevil

Scientific Name:  
*Rhynchophorus ferrugineus* (Olivier)  
Order: Coleoptera .  
Family: Curculionidae.
Global distribution of *Rhynchophorus ferrugineus* from the EPPO Global database. The detail records is provided at https://gd.eppo.int/taxon/RHYCFE/distribution
Invasion

- Native to Indian Sub-continent
- Saudi Arabia mid 1980
- UAE mid 1980
- Egypt in 1992
- Turkey 2007
- Qatar in 1996
- Jordan, and Palestine in 1999
- China 1998
- Turkey 2005
- Spain 1993
- France, Greece and Italy in 2006
- Malta and Cyprus, 2007
- Portugal in 2008
- Cyprus 2006
- Slovenia/Georgia 2009
- California 2010
Production of dates in major date producing countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Area (ha)</th>
<th>Production (million tones)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>164,695</td>
<td>848,199</td>
</tr>
<tr>
<td>Egypt</td>
<td>45,883</td>
<td>1,501,799</td>
</tr>
<tr>
<td>Iran</td>
<td>162,998</td>
<td>1,083,720</td>
</tr>
<tr>
<td>Iraq</td>
<td>125,000</td>
<td>1,083,720</td>
</tr>
<tr>
<td>Libya</td>
<td>33,877</td>
<td>174,040</td>
</tr>
<tr>
<td>Morocco</td>
<td>59,229</td>
<td>107,611</td>
</tr>
<tr>
<td>Pakistan</td>
<td>89,654</td>
<td>526,749</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>168,962</td>
<td>1,065,032</td>
</tr>
<tr>
<td>Oman</td>
<td>32,000</td>
<td>269,000</td>
</tr>
<tr>
<td>Tunisia</td>
<td>53,000</td>
<td>185,000</td>
</tr>
<tr>
<td>UAE</td>
<td>48,000</td>
<td>245,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>983,298</strong></td>
<td><strong>6,692,261</strong></td>
</tr>
</tbody>
</table>

What is the purpose of this work

• To estimate how the world's research community is responding to the pressure of this pest.
  – focus areas and neglected areas.
• Identify centers of excellence or expertise.
• Identify location of the top institutes.
• Identify foundational and newly emerging technology.
• Identify technology sub-areas.
• Build a reliable strategic plane for R&D.
Methods

Twenty Three Key Words

- Red palm weevil
- *Rhynchophorus ferrugineus*
- Pests of *Phoenix dactylifera*
- Insect pests of date palm
- Management of red palm weevil in palm plantations
- Management of red palm weevil in date palm orchards
- *Rhynchophorus ferrugineus* in Saudi Arabia
- *Rhynchophorus ferrugineus* in Middle east
- Synthetic Insecticides to control red palm weevil
- Natural insecticides for the control of red palm weevil
- Pheromones & trapping of red palm weevil
- Detection of red palm weevil
- Biological control of red palm weevil
- Rearing of red palm weevil
- Molecular aspects of red palm weevil
- Forecast of red palm weevil infestation
- Identification of red palm weevil
- Distribution of red palm weevil in Arabian peninsula and world
- Pest biology of red palm weevil
- Integrated pest management of red palm weevil
- Irradiation of red palm weevil
- Red palm weevil research articles
- Red palm weevil review articles
Major Search Engines

• ISI web of science

• CAB direct
  http://www.cabdirect.org/

• Google
  www.google.com

• Others

1980’s to February 2016  ~ 35 Years.
Results

• One Thousands one hundred forty-nine (1149) article were collected.

• Categories Used (12)
  – Review articles
  – Pheromones & Traps
  – Insecticides (Synthetic & natural)
  – Biological control
  – Detection & Forecast
  – Molecular & Cell Studies
  – Rearing
  – Identification
  – Distribution & Surveys
  – Integrated Pest Management
  – Pest Biology
  – Irradiation
Results

- **Categories Used (12)**
  - Review articles
  - Pheromones & Traps
  - Insecticides (Synthetic & natural)
  - Biological control
  - Detection & Forecast
  - Molecular & Cell Studies
  - Rearing
  - Identification
  - Distribution & Surveys
  - Integrated Pest Management
  - Pest Biology
  - Irradiation

- **Categories Used Level 1**
  - Detection & Forecast
  - Trapping
  - Pest Biology
  - Pest Prevention & Control
  - Others
Fig 1. Publication trends over the Study period 1980-2016
Top Ten Categories

Fig 2

Categorires

No. of Papers

Pheromones & Traps
Distribution & Surveys
Biological control
Molecular & Cell Studies
Integrated Pest Management
Insecticides-Synthetic & Natural
General Biology
Chemical treatment
Mes rearing
Other Detection methods
# Technical categories

## Level 1.

<table>
<thead>
<tr>
<th>Technical categories Level 1</th>
<th>Volume of Publications</th>
<th>Percentage of publication</th>
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</thead>
<tbody>
<tr>
<td>Detection &amp; Forecasting</td>
<td>71</td>
<td>6.17</td>
</tr>
<tr>
<td>Trapping</td>
<td>256</td>
<td>22.28</td>
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<tr>
<td>Pest Biology</td>
<td>190</td>
<td>16.53</td>
</tr>
<tr>
<td>Pest Prevention and Control</td>
<td>443</td>
<td>38.55</td>
</tr>
<tr>
<td>Others</td>
<td>189</td>
<td>16.44</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1149</strong></td>
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## Technical categories

### Level 1 & 2

<table>
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<tr>
<th>Technical categories Level 1</th>
<th>Technical categories Level 2</th>
<th>Volume of Publications</th>
<th>Total Volume of Publications</th>
<th>Percentage of publication</th>
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<tbody>
<tr>
<td>Detection &amp; Forecasting</td>
<td>Visual Symptoms</td>
<td>5</td>
<td>71</td>
<td>6.179</td>
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<tr>
<td></td>
<td>Audible Symptoms</td>
<td>30</td>
<td></td>
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<tr>
<td></td>
<td>Other Methods</td>
<td>36</td>
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<td></td>
</tr>
<tr>
<td>Trapping</td>
<td>Trap Designs</td>
<td>27</td>
<td>256</td>
<td>22.281</td>
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<tr>
<td></td>
<td>Phermone Traps</td>
<td>171</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other Trapping Methods</td>
<td>21</td>
<td>21</td>
<td></td>
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<tr>
<td></td>
<td>Mass Trapping</td>
<td>37</td>
<td>37</td>
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<tr>
<td>Pest Biology</td>
<td>Molecular &amp; Cell Studies</td>
<td>92</td>
<td>190</td>
<td>16.536</td>
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<tr>
<td></td>
<td>Rearing</td>
<td>30</td>
<td>30</td>
<td></td>
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<tr>
<td></td>
<td>General Biology</td>
<td>68</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>Pest Prevention and Control</td>
<td>Non-Chemical Treatments</td>
<td>34</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chemic TRT.</td>
<td>62</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bio-Control</td>
<td>145</td>
<td>145</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insecticides –Systemic &amp; Natural</td>
<td>83</td>
<td>443</td>
<td>38.555</td>
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<tr>
<td></td>
<td>IPM</td>
<td>85</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Irradiation</td>
<td>25</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>Review Articles</td>
<td>33</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Distribution and Survey</td>
<td>156</td>
<td>156</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>1149</td>
<td>%100</td>
</tr>
</tbody>
</table>
Top Publication Countries

<table>
<thead>
<tr>
<th>Publication Country</th>
<th>Volume of Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>121</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>111</td>
</tr>
<tr>
<td>Egypt</td>
<td>97</td>
</tr>
<tr>
<td>Italy</td>
<td>80</td>
</tr>
<tr>
<td>Spain</td>
<td>63</td>
</tr>
<tr>
<td>China</td>
<td>52</td>
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<tr>
<td>USA</td>
<td>34</td>
</tr>
<tr>
<td>Israel</td>
<td>21</td>
</tr>
<tr>
<td>UAE</td>
<td>17</td>
</tr>
<tr>
<td>Iran</td>
<td>16</td>
</tr>
</tbody>
</table>

- India records the highest volume of publications followed closely by Saudi Arabia and Egypt.
### Top Publication Organizations

<table>
<thead>
<tr>
<th>Name of the Institute</th>
<th>Volume of Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>King Faisal University</td>
<td>50</td>
</tr>
<tr>
<td>National Research Centre Egypt</td>
<td>29</td>
</tr>
<tr>
<td>King Saud University</td>
<td>28</td>
</tr>
<tr>
<td>University Jaume I</td>
<td>25</td>
</tr>
<tr>
<td>Chinese Academy of Tropical Agricultural Sciences</td>
<td>23</td>
</tr>
<tr>
<td>University Palermo</td>
<td>23</td>
</tr>
<tr>
<td>Plant Protection Research Institute</td>
<td>18</td>
</tr>
<tr>
<td>Central Plantation Crops Research Institute</td>
<td>17</td>
</tr>
<tr>
<td>College of Agriculture Vellayani</td>
<td>17</td>
</tr>
<tr>
<td>ICAR</td>
<td>17</td>
</tr>
</tbody>
</table>
# Single Vs Multiple

<table>
<thead>
<tr>
<th>Authors</th>
<th>Percent of Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>17%</td>
</tr>
<tr>
<td>Multiple</td>
<td>83%</td>
</tr>
</tbody>
</table>
What is the next step

Purpose

• Identify centers of excellence or expertise.
• Identify location of the top institutes.
• Identify foundational and newly emerging technology.
• Identify technology sub-areas.

Analysis

• Identify the top author and affiliations/organizations in the field.
• Identifying country of each of the top research institutes and universities.
• Highlight the key references in the field measured by citation, emphasizing significant emerging technologies when applicable.
• Segment the scientific literature references into the technical categories as closely relevant to the patent subcategories as possible.
• Identify any additional technical categories of interest covered in the scientific literature collection using any combination of data-mining techniques.

Building a strong Road Map
Example of Directed Grants
Stakeholders, Program Governance and Roles

- The Program’s most important stakeholders/enablers include:
  - MEWA
  - KACST
- Key beneficiaries include the general public, agricultural companies and farmers.
- Research community is the key contributor to the Program’s success.
- To ensure visible impact of the RPW RGP, each stakeholder’s competencies and strengths are leveraged.
- The Program is administratively supported by a Program Secretariat at KACST and governed by an Oversight Committee drawn from the key enabling stakeholders.

The Program brings these stakeholders together with clearly defined roles and responsibilities to accomplish the stated mission.
Stakeholders, Program Governance and Roles

- Stakeholders with regard to transmission of the RPW
- Network of information collection and distribution
- Regional experimental fields

MEWA

- Deep experience in research support and implementation
- Management of large, multi-stakeholder R&D programs
- Central labs and networks

KACST
Production of dates in major date producing countries (Saudi Arabia)

- 28,500,000 DP X 1/100 infes. = 285000 infes DP.
- Assume that 10% removal.
- Assume that 20-30% reduction in production due to infestations.
- Therefore, impact 30-40% deficiency in production.
- Production=285000x50kg/DP=14,250,000 kg
- 40% Loss 5,700,000 kg
- 1 kg = SR 10
- 5,700,000 X 10 = SR 57,000,000 ~ $ 15,183,803

10 years $150,000,000
• That is only productions!

What about the control and protection cost?
What do we need?

• We need a strong investments.
• We need to focus our efforts.
Conclusion and Recommendation

- Applied research in the area of Early Detections and Forecasting, Systemic insecticides, Molecular and cell biology studies are the highest priority for the future.

- Building a strong scientific network is very important tool for a good research output.

- Building a road map for R&D in the area of RPW.
 شكراً

Thank you