



## FEEDING POTENTIAL OF RED PALM WEEVIL, *Rhynchophorus ferrugineus* ON DIFFERENT DATE PALM, *Phoenix dactylifera* VARIETIES UNDER FIELD CONDITIONS

Hakim Ali Sahito<sup>1\*</sup>

Waheed Ali Kubar<sup>2</sup>

Tasneem Kousar<sup>3</sup>

Nisar Ahmed Mallah<sup>4</sup>

Faheem Ahmed Jatoi<sup>5</sup>

Wali Muhammad

Mangrio<sup>6</sup>

Bilawal uddin

Ghumro<sup>7</sup>

<sup>1,2,3,4,5,6,7</sup> Department of Zoology, Faculty of Natural Sciences, Shah Abdul Latif University, Khairpur Mir's, Sindh



(+ Corresponding author)

### ABSTRACT

#### Article History

Received: 9 June 2017

Revised: 20 July 2017

Accepted: 1 August 2017

Published: 8 August 2017

#### Keywords

Aseel

Fasly

Karbalian

Feeding

*R. ferrugineus*

Date palm.

The date palm, *Phoenix dactylifera* is one of the main cash crops of Sindh particularly of upper Sindh, district Khairpur. It is main source of nutrients such as; carbohydrates, vitamins etc. It is cultivated on 100,000 acres only in district Khairpur with total production of 293,000 tons, this production is much less as compared to other countries main cause of this low yield is the attack of date palm weevil. About, 3 species of insect pests have been recorded in Pakistan. The feeding behavior of RPW on three varieties of date palm, Aseel, Fasly and Karbalian showed that Aseel was most susceptible, weekly observation showed that the given stem piece of Aseel was completely eaten from inside by RPW, while the stem piece of two other varieties partially damaged. Present study revealed that (*Rhynchophorus ferrugineus*) weevils fed voraciously on Aseel in comparison to two other varieties those have eaten 7.58 mean % of given stem of Aseel while 6.54 of Fasly and 7.06 of Karbalian. Thus, the present study indicated that feeding behavior takes an important role towards control strategy due to lack knowledge of feeding behavior it is imperative to manage this pest.

**Contribution/Originality:** This study uses new estimation methodology of biological parameters b/c this study is one of very few studies which have been investigated from the region, Khairpur, Sindh – Pakistan on this vigorous pest of date palm orchards which would be helpful to manage the pest.

### 1. INTRODUCTION

It is consider that in cultivated plants date palm is one of the oldest plant [1, 2] which is a resourceful tree; each part of the tree is used for multipurpose like; feed and food stuff, home and kitchen material protections, and wood industry. In various countries this tree is highly regarded as national heritage. Due to its emirate characters this tree can survive in any environmental conditions, so that in recent past its production has been increased remarkably. There is need of more concern, awareness and proper guide line is required for better marketing [3]. In last few decades, the production of dates has been increased in 1963 up to 1.8 million tons, 2.6 million tons in 1983 and 6.7 million tons recorded in 2003, with annual growth of 6.8 %. Pakistan was in top five countries in 2001 along with Iraq, Iran, Egypt and Saudi Arabia these countries contributed 90% of total production of world. This clearly indicated that dates were produced by same nature of countries in the same region [4]. Baluchistan is the largest province in Pakistan which producing much dates followed by Sindh province. In 2010-2011, Sindh province was leading by production of dates due to climatic changes in weather in Balochistan. There are 150 different

varieties of dates produced in the middle of Pakistan. Major date varieties of Pakistan are Kupro, Zahidi, Maazwati, Fasli, Dhakki, Begum Jangi, Dagh, Goakna, Kharuba, Tota, Karwan, Khudrawi and Mozawati Gulistan, Jowansur, Lango, Hillav, Sabzo, Kharbalian, Karbala and Aseel etc. some of these varieties are like to those cultivated in Arab countries, Iraq and Iran [5].

The red palm weevil, *Rhynchophorus ferrugineus* Olivier (Coleoptera: Curculionidae), is an economically important, tissue-boring pest of date palm in many parts of the world. The insect was first described in India as a serious pest of coconut palm [6]. Being a main source of a big population of upper Sindh that directly/ indirectly depends on the production of dates for their lively hood, and because of its nutritional value and also one of the main source of foreign exchange there was a great need to do some work on the pest problem, which is causing severe damage to our one of most economically important crop [3, 5, 7]. [8, 9] who successfully reared the weevil on the sugarcane stem, while Rananavare, et al. [10] standardized a mass rearing method for this pest from which 50 generations were obtained subsequently. Presently, here we tried to do work on two major aspects of Red Palm Weevil, biology and feeding behavior in the laboratory under the controlled condition, as to get some basic information about time period of the life cycle (study the different larval stages, which are actually the most destructive stages) on three main varieties, Aseel, Fasly and Karbalian (commonly grown in Khairpur and other parts of upper Sindh), and its feeding behavior on these varieties, which are directly co-related to the damage. This type of study will ultimately lead us to the control of this destructive pest. Couple of research institutes is working on the growth; production etc. of different varieties of date palm grown in Sindh but completely ignored this serious problem, the date palm weevil, which is directly affecting the yield / hectare in Pakistan in general and especially in Sindh.

## 2. MATERIALS AND METHODS

### 2.1. Collection of Insects

The different life stages of adult red palm weevil male and female ( $\sigma$ : $\phi$ ) larvae and pupae were collected from infested date palm trees from local area of district Khairpur, Sindh, Pakistan during, 2015-16. The collection was brought at Entomology Laboratory, Department of Zoology, Shah Abdul Latif University, Khairpur to conduct the biological research parameters. All the life stages preferably from infested trees of date palm of some commonly grown varieties, but for the research study under the laboratory conditions only selection was made on most popularly consumed three varieties like; Aseel, Fasly and Karbalian. The collection of adult and larvae was made by hand picking from tree trunk of date palm orchards. Those specimens were kept separately as variety wise in different glass jars (2x4") kept at laboratory conditions at constant temperature of  $25\pm 2^{\circ}\text{C}$  and relative humidity 60-65%. These glass jars were also labeled with the variety wise. The incubator instrument for temperature control was used for incubation purpose at lab conditions.

After collection from field the adult male and female ( $\sigma$ : $\phi$ ) brought into laboratory for proper identification and rearing. The male had a patch of brown hairs on half of rostrum, while female was without patch of brown hairs. The males were relatively shorter in size than female. After identification of each pair (male and female) kept in separate glass jars and food was provided them with stem piece of date palm tree of all three varieties, Aseel, Fasly and Karbalian which measured (6 cm size long) and weight was 50 grams to each larval instars like; first to seventh. The given pieces were changed on weekly basis before the food providing such a size and weight of infested stem piece was measured by Electronic weigh balance. The mating and egg laying took place in these glass jars. The cap of glass jars was covered with muslin cloth for ventilation purpose. After crossing three successive generations in the laboratory, were reared on three different varieties of date palm successfully and further observations were started for an authentication. And monitored the comparative feeding behavior of all larval instars for observing that how much damage of each instars can cause and which stage / instar is most dangerous for the date palm tree. This whole process was continued for three successive generations and data was collected

and analyzed to observe the percentage of damage and monitor the varietal susceptibility of date palm against this pest.

## 2.2. Statistical Analysis

Finally, the data was inserted in MS, excel spread sheet and latter on imported for analysis of variance for testing the significant results with the help of SXW software, 8.1, version (USA).

## 3. RESULTS

### 3.1. Field Observations of Date Palm Orchards

The collection of different life stages of Red palm weevil, *Rhynchophorus ferrugineus* were made and reared under the laboratory conditions for proper identification. During the survey of different orchards the attack of date palm tree was observed very difficult because this pest concealed the holes after oviposition. Hatched larvae bored into the stem, and the whole development took place inside the tree trunk that's why, they were and are being called as concealed tissue borer insect pest. The presence of larvae was only detected by the occurrence of tunnels in the trunk, at the base of leaf petioles and through the presence of frass and plant sap on the ground around the tree, which ooze from those tunnels. When the red palm weevil completely destroyed the one date palm tree, then moved to other tree, and the whole process started again; male start again to attack on new tree and produce a pheromone which cause female to aggregate that tree once again.

### 3.2. Different Basic Larval Instars Damage on Three Date Palm Varieties

We have observed the feeding behavior of all larval stages on three varieties, Aseel, Fasly and Karbalian for three successive generations. The first stage regarding data of feeding pattern of three successive generations showed significantly different ( $P<0.05$ ). The first larval instars were injurious and caused serious damage to date palm tree. But the most destructive was variety Aseel which consumed the maximum amount of food with the overall mean  $1.25\pm 0.09\%$ , while lowest consumption was by Fasly  $1.01\pm 0.02\%$ . The data of feeding pattern of three successive generations showed significant ( $P<0.001$ ) difference of the second larval instars, were injurious and caused serious damage to date palm tree.

Table-1. The damage caused by different larval instars (3 generations) on three date palm varieties

First larval stage				
Name of varieties	Generation I damage in gm	Generation II damage in gm	Generation III damage in gm	Mean+SE
Aseel	1.28	1.31	1.15	$1.25\pm 0.09$
Fasly	1.02	0.99	1.02	$1.01\pm 0.02$
Karbalian	1.19	1.22	1.12	$1.18\pm 0.05$
Second larval stage				
Aseel	2.73	2.68	2.51	$2.64\pm 0.12$
Fasly	1.66	1.70	1.69	$1.68\pm 0.02$
Karbalian	2.48	2.41	2.43	$2.44\pm 0.04$
Third larval stage				
Aseel	4.58	4.64	4.62	$4.61\pm 0.03$
Fasly	3.22	3.34	3.11	$3.16\pm 0.03$
Karbalian	3.71	3.67	3.64	$3.67\pm 0.04$
Fourth larval stage				
Aseel	7.35	7.24	7.15	$7.25\pm 0.10$
Fasly	5.88	5.82	5.81	$5.58\pm 0.04$
Karbalian	6.78	6.73	6.71	$6.76\pm 0.04$

Each value is a mean of 4 replications which are significantly different  $p<0.05$ .

But the most destructive variety was Aseel that consumed the maximum amount of food that was  $2.64 \pm 0.12\%$ , while lowest consumption was by Fasly  $1.68 \pm 0.02\%$ . The data of feeding pattern of three successive generations showed significantly different ( $P < 0.001$ ) on the third larval stages which were also injurious. But the most destructive variety found was Aseel that consumed the maximum amount of food which was  $4.61 \pm 0.03\%$ , while lowest consumption was by Fasly which was  $3.16 \pm 0.03\%$ . The data of feeding pattern of three successive generations showed significantly different ( $P < 0.001$ ) to the fourth larval instars which were also found the injurious and caused serious damage to date palm tree. But the most destructive variety was Aseel that consumed the maximum amount of food  $7.25 \pm 0.10\%$ , while lowest consumption was by Fasly  $5.58 \pm 0.04\%$  in all three generations (Table -1), respectively.

### 3.3. Different Major Larval Stages Harm to Date Palm Varieties

It was also observed the feeding behavior of fifth larval instars on three varieties namely; Aseel, Fasly and Karbalian for three successive generations. The data of feeding pattern of three successive generations showed significantly different ( $P < 0.001$ ) to the fifth larval instars which was injurious. But the most destructive variety found was Aseel that was consumed the maximum amount of food with overall mean  $10.19 \pm 0.11\%$ , while lowest consumption was by Fasly  $9.23 \pm 0.05\%$ . Besides, the further data on sixth larval instars was also found significantly different ( $P < 0.001$ ). But the most destructive variety was Aseel which consumed the maximum amount of food up to  $12.88 \pm 0.03\%$ , while lowest consumption was by Fasly  $11.58 \pm 0.06\%$ . Thus; the data was also showed significantly different ( $P < 0.001$ ) to the seventh larval instars which was observed also much injurious and caused serious damage to date palm tree. But the most destructive variety was Aseel that consumed the maximum amount of food up to  $14.23 \pm 0.10\%$ , while lowest consumption by variety Fasly  $13.27 \pm 0.13\%$  in all three generations (Table -2 and Fig. 1).

Table-2. The damage caused by different larval instars (3 generations) on three date palm varieties

<b>Fifth larval stage</b>				
<b>Name of Varieties</b>	<b>Generation I damage in gm</b>	<b>Generation II damage in gm</b>	<b>Generation III damage in gm</b>	<b>Mean+SE</b>
Aseel	10.32	10.11	10.14	10.19±0.11
Fasly	9.21	9.29	9.19	9.23±0.05
Karbalian	9.62	9.51	9.53	9.55±0.06
<b>Sixth larval stage</b>				
Aseel	12.92	12.87	12.86	12.88±0.03
Fasly	11.65	11.57	11.53	11.58±0.06
Karbalian	11.87	11.91	11.94	11.91±0.04
<b>Seventh larval stage</b>				
Aseel	14.34	14.14	14.22	14.23±0.10
Fasly	13.14	13.27	13.39	13.27±0.13
Karbalian	13.96	13.91	13.88	13.92±0.04

Each value is a mean of 4 replications which are significantly different  $p < 0.05$ .



Fig-1. Showing all life stages of Red palm Weevil (photo: Kubar and Sahito through digital camera)

#### 4. DISCUSSION

Date palm fields of local areas of district Khairpur were surveyed as to monitor the presence / absence of *R. ferrugineus* which is causing severe infestation to date palm tree trunk and found noticeable infestation to the many varieties. Present study was based on the component to observe the feeding behavior on these three varieties as to get the knowledge that which variety is more susceptible to Red palm weevil, *Rhynchophorus ferrugineus* (Oliv.) (Coleoptera: Curculionidae). Among all three varieties Aseel was most commonly grown in this region because of good fruit quality; this is the variety which people export to Asian countries. We recorded seven larval instars on all three date palm varieties, the same number was recorded by many researchers like; [Jaya, et al. \[11\]](#); [Faghih \[12\]](#); [Rahalkar, et al. \[8\]](#); [Butani \[13\]](#) but some researchers like [Shahina, et al. \[14\]](#) reported nine, [Abe, et al. \[15\]](#) reported 12, [Nirula \[16\]](#) reported 3, and [Salama, et al. \[17\]](#) reported 5 larval instars, on different diets. We recorded the shortest pupal period on Aseel (14-21 days) while it was same on (18-30 days) Fasly and Karbalian. Other researchers also had same findings on different diets which included both artificial and natural diet, [Shahina, et al. \[14\]](#) reported 20-30 days, [Kranz, et al. \[18\]](#) reported 14-21 days, [\[19, 20\]](#) reported 21 days with the a dangerous pest was mass reared on sugarcane and artificial diets, and its mating behavior and [\[21, 22\]](#) reported 18-33 days. While; our results were not comparable with [Leefmans \[23\]](#) who reported 13-15 days and [Esteban-Duran, et al. \[24\]](#) reported 19-45 days. During present study of feeding behavior, it was observed that the Aseel variety was most susceptible among all three varieties the consumption of food by Red Palm Weevil was high on Aseel than Karbalian and Fasly might be of high sugar content and soft trunk fiber. During the survey of different palm fields in District Khairpur we have found that the trunks of some of severely infested trees were broken. [Abraham, et al. \[25\]](#) had same kind of findings. According to [Gunawardena and Bandarage \[26\]](#) the male of Red Palm Weevil produced a pheromone which cause the weevil to aggregate on damaged tree we have also found the adult male and female in the tree crown, upper barks of the trunk and at the base of petioles, from where they can bore into the trunk of young palm and the decaying tissue of dying palms.

#### 5. CONCLUSION

It is concluded that the feeding behavior of red palm weevil showed that Aseel is most favorable food for it, and it caused severe damage to tree trunk, made it almost hollow. We assume that because of soft trunk fibers and more sugar content *R. ferrugineus* fed voraciously on it and causing tree severe damage. Further, we recommended that the basic and preliminary kind of work towards the control of red palm weevil. But we presuppose that dates, being a

one of cash crop of district Khairpur, Sindh - Pakistan need a more attention to do more work on other varieties grown in Sindh in relation to weevil infestation and do some work on biological control.

**Funding:** This study received no specific financial support.

**Competing Interests:** The authors declare that they have no competing interests.

**Contributors/Acknowledgement:** All authors contributed equally to the conception and design of the study.

## REFERENCES

- [1] D. R. Lee, "Date cultivation in the Coachella Valley California," *Ohio Journal of Science*, vol. 63, pp. 82-87, 1963.
- [2] M. Riad, "The date palm sector in Egypt," *CIHEAM- Options Mediterraneennes*, pp. 45-53, 2006.
- [3] H. A. Sahito, N. A. Mallah, T. Kousar, W. A. Kubar, Z. H. Shah, F. A. Jatoi, and W. M. Mangrio, "Life table parameters of saw toothed grain beetle, *oryzaephilus surinamensis* (L., 1758) on different varieties of stored date palm fruits infested under laboratory conditions," *Journal of Entomology and Zoology Studies*, vol. 5, pp. 95-99, 2017. [View at Google Scholar](#)
- [4] W. Erskine, A. T. Moustafa, A. E. Osman, Z. Lashine, A. Nejatian, T. Badawi, and S. M. Ragy, "Date palm in the GCC countries of the Arabian Peninsula." Retrieved <http://www.icarda.org/APRP/Datepalm/introduction/intro-body.htm>, 2003.
- [5] N. A. Mallah, H. A. Sahito, T. Kousar, W. A. Kubar, F. A. Jatoi, and Z. H. Shah, "Susceptibility of different varieties of stored date palm fruits infested by saw tooth grain beetle, *oryzaephilus surinamensis* (L., 1758) under laboratory conditions," *Journal of Entomology and Zoology Studies*, vol. 4, pp. 438-443, 2016. [View at Google Scholar](#)
- [6] H. M. Lefroy, *The more important insects injurious to Indian agriculture*. Calcutta, India.: Govt. Press, 1906.
- [7] N. A. Mallah, H. A. Sahito, T. Kousar, W. A. Kubar, F. A. Jatoi, Z. H. Shah, and W. M. Mangrio, "Varietal analyze of chemical composition moisture, ash and sugar of date palm fruits," *Journal of Advanced Botany and Zoology*, vol. 5, pp. 1-5, 2017.
- [8] G. W. Rahalkar, M. R. Harwalkar, and H. D. Rananavare, "Development of red palm weevil, *Rhynchophorus ferrugineus*," *Olives Indian Journal of Entomology*, vol. 34, pp. 213-215, 1972.
- [9] G. W. Rahalkar, A. J. Tamhankar, and K. Shanthram, "An artificial diet for rearing red palm weevil, *rhynchophorus ferrugineus oliv*," *Journal of Plantation Crops*, vol. 6, pp. 61-64, 1978.
- [10] A. Rananavare, J. K. Shanthram, M. R. Harwalkar, and G. W. Rahalkar, "Method for the laboratory rearing of red palm weevil, *rhynchophorus ferrugineus oliv*," *Journal of Plantation Crops*, vol. 3, pp. 65-67, 1975. [View at Google Scholar](#)
- [11] S. Jaya, T. Suresh, R. S. Sobhitha-Rani, and S. Sreekumar, "Evidence of seven larval instars in the red palm weevil, *Rhynchophorus ferrugineus olivier* reared on sugarcane," *Journal of Entomological Research*, vol. 24, pp. 27-31, 2000. [View at Google Scholar](#)
- [12] A. A. Faghieh, "The biology of red palm weevil, *rhynchophorus ferrugineus oliv*. (Coleoptera: Curculionidae) in Savaran region (Sistan Province, Iran)," *Applied Entomology & Phytopathology*, vol. 63, pp. 16-86, 1996. [View at Google Scholar](#)
- [13] D. K. Butani, "Insect pests of fruit crops and their control, sapota-11," *Pesticides Research Journal*, vol. 9, pp. 40-42, 1975.
- [14] F. Shahina, J. Salma, G. Mehreen, M. I. Bhatti, and K. A. Tabassum, "Rearing of *Rhynchophorus ferrugineus* in laboratory and field conditions for carrying out various efficacy studies using EPNs," *Pakistan Journal of Nematology*, vol. 27, pp. 219-228, 2009. [View at Google Scholar](#)
- [15] F. Abe, K. Hata, and K. Sone, "Life history of the red palm weevil, *rhynchophorus ferrugineus* (Coleoptera: Driophthoridae), in Southern Japan," *Florida Entomologist*, vol. 92, pp. 421-425, 2009. [View at Google Scholar](#) | [View at Publisher](#)
- [16] K. K. Nirula, "Investigations on the pests of coconut palm. Part IV. *Rhynchophorus ferrugineus*," *Indian Coconut Journal*, vol. 9, pp. 229-247, 1956.

- [17] H. S. Salama, F. N. Zaki, and A. S. Abdel-Razek, "Ecological and biological studies on the red palm weevil *Rhynchophorus ferrugineus* (Olivier)," *Archives of Phytopathology and Plant Protection*, vol. 42, pp. 392–399, 2009. [View at Google Scholar](#)
- [18] J. H. Kranz, H. Schmutterer, and W. Koc, *Enfermedades, pagasy malezas de los cultivos subtropicales*. Berlin, Germany: Verlag Paul Parey, 1982.
- [19] W. Kaakeh, "The mating behavior of the red palm weevil, *rhynchophorus ferrugineus* oliv. (Coleoptera: Curculionidae)," *Emirates Journal of Food and Agriculture*, vol. 10, pp. 24–46, 1998. [View at Google Scholar](#) | [View at Publisher](#)
- [20] W. Kaakeh, "Longevity, fecundity, and fertility of the red palm weevil, *rhynchophorus ferrugineus* olivier (Coleoptera: Curculionidae) on natural and artificial diets," *Emirates Journal of Agricultural Sciences*, vol. 17, pp. 23–33, 2005. [View at Google Scholar](#) | [View at Publisher](#)
- [21] C. C. Ghosh, "The palm beetles in Burma with notes on other pests," *Bulletin of the Department of Agriculture*, vol. 19, pp. 1–40, 1923. [View at Google Scholar](#)
- [22] C. C. Ghosh, "Life history of Indian insects – III. The Rhinoceros beetle (*Oryctes Rhinoceros*) and the red palm weevil (*Rhynchophorus Ferrugineus*)," *Memoirs of the Department of Agriculture*, vol. 2, pp. 205–217, 1912. [View at Google Scholar](#)
- [23] S. Leefmans, "Date palmsnuitkever (*Rhynchophorus Ferrugineus* Olivier)," *Mededelingen van Het Instituute voor Plantenziekten*, vol. 43, pp. 1–90, 1920. [View at Google Scholar](#)
- [24] J. Esteban-Duran, J. L. Yela, F. Beitia-Crespo, and Jimenez-Alvarez, "Biology of the red palm weevil *rhynchophorus ferrugineus*(Olivier) in the laboratory and field: Life cycle, biological characteristics in its zone of introduction in Spain, biological methods of detection and possible control," *Boletin de Sonidad Vegetal*, vol. 24, pp. 737–748, 1998.
- [25] V. A. Abraham, M. A. Al Shuaibi, J. A. Faleiro, R. A. Abuzuhairah, and P. S. Vidyassagar, "An integrated management approach for red palm weevil, *Rhynchophorus ferrugineus* Oliv., a key pest of date palm in the Middle East," *Sultan Qaboos University Journal for Scientific Research–Agricultural Sciences*, vol. 3, pp. 77–84, 1998. [View at Google Scholar](#) | [View at Publisher](#)
- [26] N. E. Gunawardena and U. K. Bandarage, "4-Methyl-5-nonanol ferrugineol)as an aggregation pheromone of the coconut pest, *rhynchophorusferrugineus* F.(Coleoptera: Curculionidae): synthesis and use in apreliminary field assay," *Journal of the National Science Council of Sri Lanka*, vol. 23, pp. 71–79, 1995. [View at Google Scholar](#) | [View at Publisher](#)

*Views and opinions expressed in this article are the views and opinions of the author(s), Current Research in Agricultural Sciences shall not be responsible or answerable for any loss, damage or liability etc. caused in relation to/arising out of the use of the content.*