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Hakim Ali Sahito
Department of Zoology, Faculty of Natural Sciences, Shah Abdul Latif University, Khairpur, Pakistan

Nisar Ahmed Mallah
Department of Zoology, Faculty of Natural Sciences, Shah Abdul Latif University, Khairpur, Pakistan

Tasneem Kousar
Department of Zoology, Faculty of Natural Sciences, Shah Abdul Latif University, Khairpur, Pakistan

Waheed Ali Kubar
Department of Zoology, Faculty of Natural Sciences, Shah Abdul Latif University, Khairpur, Pakistan

Zafar Hussain Shah
Department of Zoology, Faculty of Natural Sciences, Shah Abdul Latif University, Khairpur, Pakistan

Faheem Ahmed Jatoi
Department of Zoology, Faculty of Natural Sciences, Shah Abdul Latif University, Khairpur, Pakistan

Wali Muhammad Mangrio
Department of Zoology, Faculty of Natural Sciences, Shah Abdul Latif University, Khairpur, Pakistan

Correspondence
Hakim Ali Sahito
Department of Zoology, Faculty of Natural Sciences, Shah Abdul Latif University, Khairpur, Pakistan
Email: hakim.sahito@salu.ed.pk

Life table parameters of saw toothed grain beetle, *Oryzaephilus surinamensis* (L., 1758) on different varieties of stored date palm fruits infested under laboratory conditions

Hakim Ali Sahito, Nisar Ahmed Mallah, Tasneem Kousar, Waheed Ali Kubar, Zafar Hussain Shah, Faheem Ahmed Jatoi and Wali Muhammad Mangrio

Abstract
The date palm, *Phoenix dactylifera* (L.) fruit is a very important source of nutrients and cash crop of Sindh, Pakistan because of ideal climatic conditions for cultivation. The commercially important varieties are grown namely; Kupro, Karbalian, Aseel, Fasly and Dadhi. The research study was carried out under laboratory conditions from August, 2015 to April, 2016. During storage process these varieties were infested by saw toothed grain beetle, *Oryzaephilus surinamensis* (L). The maximum survival rate was recorded 88% on Kupro and lowest 46.51% on Dadhi varieties. The study revealed that Kupro and Karbalian semi-dry varieties were more attractive to pest as compared to Aseel and Dadhi dry, the reason might be because of attraction was high sugar and moisture contents.

Keywords: Survival, mortality, saw toothed grain beetle and *Phoenix dactylifera*

1. Introduction
The saw toothed grain beetle, *Oryzaephilus surinamensis* (L., 1758) (Coleoptera: Silvanidae) reducing the dates quality as well as quantity and weight loss on stored dry and semi-dry (fresh) fruits of date palm face a critical problem of insects infestation. The strong chewing mouth parts allow them to access food which is stored inside boxes. They try to enter inside the material, they attract to stored material due to its smell and odor. Therefore, they will make every attempt to find their way inside. Like other fruits, date palm have got some production problems and its fruits are attacked by a number of pests such as; black palm beetle, *Oryctes rhinoceros*, Linnaeus, greater date moth, *Arenipses sabella*, Hampsm, red palm weevil, *Rhynchophorus ferrugineus*, Oli, lesser date moth, *Batrachedra amydraula* Meyrick, Scales and mites as well [1, 2]. Although, the biology of saw-toothed grain beetle has been studied by many authors [3-7] but the rearing process to get good production of off-spring is still a challenge because of the small size of the insect and high mobility.
Date palm, *Phoenix dactylifera* (L.) is an area under cultivation of dates in Pakistan and Sindh was 84,700 and 29, 300 hectares and its total production were 426,300 and 201,100, respectively tons [8]. There are about more than 300 varieties of date palm cultivated in Pakistan. Sindh is also known as the biodiversity centre of dates. Several varieties are similar to those cultivated in Iraq, Iran and the Gulf countries like; Hillawi, Zahidi, Shakeri, Basri etc. about 85% of date-palm crop is cultivated in district: Khairpur Mir's Sindh [9, 10]. The major producing countries date palm has regarded as more important crop than others. The growth of date palm has been gradually decreased due to infestation of pest and disease problems [11]. Although at present time Pakistan is included in major date palm producing countries of the world. It can easily improve the production and protected from pet by the improving management and an organization skills, such as; pre-harvesting, harvesting and post-harvesting. It is shown in district: Khairpur Mir's that approximately; 20% of the date fruit is completely destroyed due to poor managing and very old methods. The date-palm Research Centers and other Research institute of Khairpur have needed to work with the farmers in this view. Keeping in view, it was necessary to know about basis thinks therefore; the research study was conducted on the life table, biological parameters of this vigorous pest.

The findings will pave the way to the new researchers of the date palm keeping orchards and stored dates fruit.

2. Materials and Methods

2.1 Collection of insects

The dates contaminated by pest, *O. surinamensis* were collected from the stores, shops, homes, Khajoor Mandy of Khairpur and Chuhara Mandy of district: Khairpur, after collection those infected dates were brought under laboratory conditions for the culture maintenance. The observations were made on weekly basis on survival and mortality % with life stages on different date palm fruit varieties.

2.2 Artificial infestation by saw toothed grain beetle, *O. surinamensis*

The pest saw toothed grain beetle, *O. surinamensis* reared on different kind of semi-dry and dry varieties of stored date palm fruit namely; Kupro, Karbalian, Aseel, Fasli (semi-dry dates) and Aseel and Dadhi (dry dates) under room temperature in the Laboratory of Entomology, Department of Zoology, Shah Abdul Latif University, Khairpur during the consequent years from the August, 2015 to April, 2016. For this research study the plastic jars about 1.5 kg capacities were used for pest rearing. The above named dates of different varieties were infested by 10 pairs of adults saw toothed grain beetle. The examination leads for determination of biological parameters such as; survival and mortality percentage with life stages of the pest. The number of living and dead insects was calculated to determine the rate of mortality and the population ratio of the saw toothed grain through under given formula:

$$\text{Rate of mortality} = \frac{\text{No. of dead insects}}{\text{Total no. of insects}} \times 100$$

$$\text{Survival percentage} = \frac{\text{No. of survival insects}}{\text{Total no. of insects}} \times 100$$

3. Results

3.1 Survival and mortality percentage with life stages of saw toothed grain beetle on different date palm fruit varieties

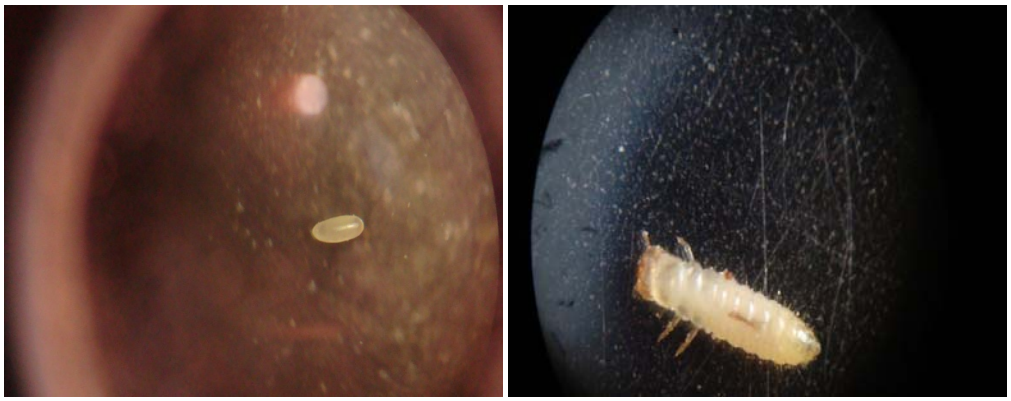
However, rearing of this pest is not a simple task, mainly because of its feeding behavior, small size and high mobility. Thus, the aim of this research was to develop a simple rearing method for *O. surinamensis* using stored date palm fruits. It was observed that one life cycle (egg to adult) completed almost in 30-40 days. The number of eggs, larvae, pupae and adults was counted along with survival and mortality ratio (Fig. 1). The growth rate was observed the highest in Kupro variety (semi-dry date) and the lowest in Dadhi variety (dry date). The Kupro variety has also soft and tender flesh compare to other remaining varieties, so that the beetles were easily stay and feed on Kupro dates. The life table of saw toothed grain beetle on fruit of semi-dry Kupro variety showed the maximum survival percentage on pupal stage, which was 97.77% and the survival percentage on larval stage was 93.75%. But maximum mortality percentage was recorded on larval stage 6.25% and minimum on pupal stage 2.27%. The total survival rate of saw toothed grain beetle on fruit of semi-dry Kupro variety was recorded 88% and total mortality rate 12%. The results indicated that this variety is highly attractive to saw toothed grain beetle because of having the highest percentage of moisture and sugar, there were also another reason of more survival rate, the fruit of this variety is very soft, tender and also foam like, so it was easily influenced and harmed by saw toothed grain beetle, due to that it was more susceptible.

The life table of saw toothed grain beetle on fruit of semi-dry Karbalian variety showed the maximum survival percentage on pupal stage, which was 90.90% and the lowest survival percentage on larval stage was 82.50% and maximum mortality was recorded on larval stage, 17.50% and minimum on pupal stage, 9.90% and total survival rate 83.33% and total mortality rate 16.66%. On fruit of semi-dry Aseel variety showed the maximum survival percentage on pupal stage 97.56% and the lowest survival percentage on larval stage 91.11% with maximum mortality on larval stage 8.88% and minimum on pupal stage 2.43% and the total survival rate 66.66% and mortality rate 33.33%, respectively. On fruit of semi-dry Fasli variety showed the 93.54% and 78.48% with mortality on larval stage 20.51% and on pupal stage 6.45% and survival rate 65.90% and mortality rate 34.09%. On fruit of dry Aseel variety showed the result on pupal stage 77.77% and on larval stage 75% with mortality on larval stage 25% and on pupal stage 22.22% with survival rate 48.83% and mortality rate 51.16%, respectively. On fruit of dry Dadhi variety showed survival on pupal stage 76.92% and survival on larval stage 74.28% and mortality on larval stage 25.71% and on pupal stage 18.60% with survival rate 46.51% and mortality rate 53.48%, respectively (Table- 1).

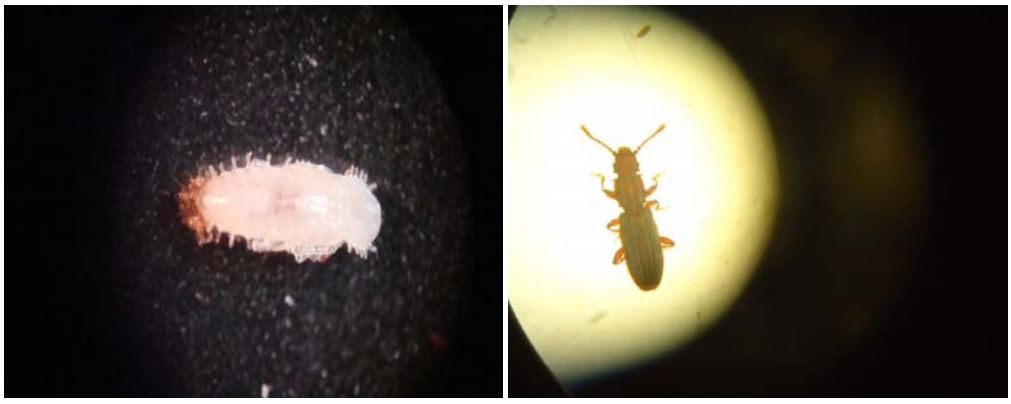
Table 1: Life table of saw toothed grain beetle on different varieties under laboratory conditions

Variety- 1	**Kupro semi-dry date**			
Life stages	**No.**	**Survive to next stage**	**Survival %**	**Mortality %**
Egg	500	480	96	4
Larva	480	450	93.75	6.25
Pupa	450	440	97.77	2.27
Adult	440	---	---	---
Total survival and mortality %			88	12
Variety- 2	**Karbalian semi-dry dates**			
Egg	480	450	88.88	11.11
Larva	450	410	82.50	17.50
Pupa	410	400	90.90	9.09
Adult	400	---	---	---
Total survival and mortality %			83.33	16.66
Variety- 3	**Aseel semi-dry dates**			
Egg	450	400	93.75	6.25
Larva	400	330	91.11	8.88
Pupa	330	300	97.56	2.43

Adult	300	---	---	---
Total survival and mortality %			66.66	33.33
Variety- 4	**Fasli semi-dry dates**			
Egg	440	390	88.63	11.36
Larva	390	310	78.48	20.51
Pupa	310	290	93.54	6.45
Adult	290	---	---	---
Total survival & mortality %			65.90	34.09
Variety- 5	**Aseel dry date**			
Egg	430	360	83.72	16.27
Larva	360	270	75.00	25.00
Pupa	270	210	77.77	22.22
Adult	210	---	---	---
Total survival and mortality %			48.83	51.16
Variety- 6	**Dadhi dry date**			
Egg	430	350	81.39	18.60
Larva	350	260	74.28	25.71
Pupa	260	200	76.92	23.07
Adult	200	---	---	---
Total survival and mortality %			46.51	53.48



Egg Larvae



Pupae Adult

Fig 1: Life table parameters of sow toothed grain beetle under laboratory conditions

4. Discussion

For this study we reared saw toothed grain beetle on main varieties of semi-dry dates such as; Kupro, Karbalian, Aseel and Fasli and dry dates Aseel and Dadhi. Present study was based on to check the difference in growth rate of saw toothed grain beetle on various varieties of date palm fruit. The results showed the significant differences between semi-dry and dry dates with the rate of development, mortality and survival rate of *O. surinamensis.* The results indicated that the maximum population of *O. surinamensis* was observed on semi-dry date varieties Kupro and Karbalian, while on dry date varieties the population was less. On Kupro 440 mature stage adults and on Karbalian 400 mature stage adults were counted, while on Aseel 210 and on Dadhi 200 mature stage of adults were counted. The maximum survival percentage was found on Kupro (88%) and Karbalian (83.33%), while the minimum was observed on Aseel (48.83%) and Dadhi (46.51%). The total average mortality percentage maximum was showed on Dadhi (53.48%), while the minimum was showed on Kupro (12%). Like this and other scientists who also [12] evaluated some characteristics of date palm and conducted the study on the chemical composition of dates at different stages of maturity for the varietal characterization of various cultivars of date palm, *Phoenix dactylifera* (L.). It is known as the best

fruit food of the world [13] the chemical composition of date varieties as influenced by the stage of ripening [14]. It is also known with its individuality by name with the date palm, *Phoenix dactylifera* plant which is an ancient plant of the world [15]. On which [16] worked on the behavioral responses of saw toothed grain beetle as a pest besides, [17] observed the mortality rate of saw toothed grain beetle showing on wheat treated with diatomaceous earth effects of temperature and relative humidity. On susceptibility of some dry date-palm varieties to infestation by saw toothed grain beetle in relation to their chemical composition were also evaluated by [18].

The saw toothed grain beetle was slender, flat in shape, brown in color and it was only 3 mm long. Adults usually live about 6 to 10 months, with some living as long as 3 years, which is quiet long for an insect so small. Eggs will hatch into larvae within a couple of weeks and start to feed immediately, larvae are ready to pupate they cover themselves with the pieces of food product. The larvae and adults both feed voraciously on dates [5, 6]. Whereas, another scientists [19, 20] reported that the larval and adult stages are very active stages for the feeding behavior, while the egg and pupal are inactive stages. The eggs of *O. surinamensis* failed to hatch and pupal survival stage decreased above 40 ˚C and below 15 ˚C temperature [7]. Further, the between 25-33 ˚C temperature was favorable for the development of *O. surinamensis* and the lower mortality of adults at 22-27 ˚C [21]. On grain insect species the factors such as; moisture, sugar content, temperature and duration of contact all influenced the mortality of stored-produced insects. The susceptibility of different varieties of stored date palm fruits infested by saw toothed grain beetle under laboratory conditions in which five different kinds of varieties were kept under observations [22, 23]. The some insecticides are being resistant against, *O. surinamensis* in New South Wales and Queensland [2]. But it is also recommended that the *Oryzaephilus surinamensis* is easy to control at egg and larval stages because these stages are very sensitive and vulnerable. Radiation technique offers an alternative method for the pest control because it requires less time, leaves no residue and can be as effective as fumigants. Because the Date palm, *P. dactylifera* is known as heavenly fruit, its properties have been described in most of the religious books and the most ancient tree. Whereas; the Pakistan is the sixth largest producer of the dates in the world so, it is further concluded that it should be get safest from different pests as well as its fruits especially from saw toothed grain beetle to know from its biological parameters.

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