Research articles

A simple laboratory rearing protocol for the longhorn date palm borer, *Jebusaea hammerschmidtii* (Reiche, 1878) (Coleoptera: Cerambycidae)

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Abstract

The date palm longhorn beetle, *Jebusaea hammerschmidtii* (Reiche)(Coleoptera: Cerambycidae) has emerged as a key pest of date palm, *Phoenix dactylifera* L. Little information is known on the biology of this beetle, due to its cryptic feeding behavior, relatively long period of larval stage, seasonality and short life of adults. We developed a simple laboratory rearing protocol, where the larvae were successfully reared to adult stage with 65% rearing efficiency. The details of the rearing protocol and measures to optimize it are discussed.

Introduction

The date palm longhorn beetle (LHB), *Jebusaea hammerschmidtii*is an extremely destructive pest of edible date palm *Phoenix dactylifera* L. (Aldryhim, 2008; Ali and Hama, 2016; El-Shafie and Mohammed, 2016). This insect has a high degree of specificity to the date palm (Blumberg, 2008). The life cycle of LHB takes almost a year and the larval stage, which is responsible for the damage may take about 11 months. There is only one generation per year (univoltine) and the adult beetles appear for a short period during May-June (El-Shafie, 2021).The larvae, which are the damaging stage, create feeding and hiding tunnels in the base of fronds and the trunk, and in severe infestation, they may reach the apical meristem causing eventual death of the palm (El-Shafie, 2021) (Figure 1).

Figure 1. Larval damage of *J. hammerschmidtii* on the apical meristem of date palm offshoot

The pest is capable of destroying the entire date palm plantation if infestation is not detected at an early stage and management measures are adopted. Until recently there was a few published information on this beetle. Dias *et al*., (2021) reported that the mitochondrial genome of *J. hammerschmidtii* includes 15619 bp and contains 13 protein coding, 22 transfer RNAs, and 2 ribosomal RNAs genes. The phylogenetic analysis placed the beetle within the subfamily Cerambycinae and the gene content and organization were identical to other Cerambycid beetles.

Many factors have contributed to the difficulty of studying the biology of the LHB, notably the seasonality of adults, the relatively long larval period, and the cryptic nature of larvae, which usually develop in galleries inside the date palm trunk (El-Shafie, 2015, 2021). Little information is available on the biological parameters of this species due to lack of rearing and handling protocols (Keena, 2017). For rearing *J. hammerschmidtii* under semi-field conditions, Al-Saadi (2017) used a feeding substrate consisted of pulverized tissue of date palm trunk and date syrup (Dips) with a ratio of 95: 5 moistened with distilled water. In an attempt to overcome the rearing difficulties of this pest, the present work has been carried out to develop a simple, affordable, and reliable protocol for rearing the longhorn beetle in the laboratory for availing enough test insects of high quality for the different experiments.

Materials and methods

Larvae of different ages and sizes were collected during October 2020 from the frond bases of highly infested date palms selected from the orchard of the Date Palm Research Center of Excellence, King Faisal University Al-Ahsa, Saudi Arabia (Latitude: 25.268528 °N, Longitude: 49.707218 °E). A chisel and forceps was used to retrieve and remove the larvae from their feeding galleries at the bases of old fronds (Figure 2). The larvae were then put in plastic boxes containing chewed palm tissues and frass collected from the feeding tunnels and were brought to the laboratory (Figure 2).

Figure 2 *J. hammerschmidtii* larvae at the feeding galleries (left), larvae collected in plastic box (right)

In the laboratory, the larvae were rinsed with distilled water to remove plant debris and chewed tissues of the infested palm that were adhered at their bodies and they were put on a tissue paper to dry before being transferred into cut fronds used as feeding substrate (Figure 3).

Figure 3. Collected larvae of *J. hammerschmidtii* after being washed with distilled water

Freshly cut bases of date palm frond (petioles) were used as substrate for rearing larvae. The frond bases were longitudinally cut into two equal parts using an electric saw and small groove was made in the inner side of one part to accommodate a developing larva. A larva was introduced into each cut frond base, and the two parts of the frond were fastened together and held in place using a metal wire (Figure 4). Larvae were reared individually to avoid cannibalism (Keena, 2017). The developing larvae inside the fronds were then putin a wire mesh cage in the laboratory. Old frond bases (desiccated tissues) were changed every month and larvae were carefully moved to fresh petioles (Figure 5).

Figure 4. Freshly cut date palm frond bases, each frond containing one larva of *J. hammerschmidtii*

Figure 5. Old date palm frond bases showing larval feeding frass, molt skins and pupal chambers of *J. hammerschmidtii*

Results and discussion

Through the above mentioned rearing protocol, *J. hammerschmidtii* larvae were successfully reared to the adult stage (Figure 6).

The rearing efficiency was above 65% indicating that some refinement of the method may be needed to increase this percentage. Under semi-field conditions, 85% efficiency of adult emergence was obtained (Al-Saeedi, 2019). The most important problems facing this

rearing protocol are the fungal and mite contamination and desiccation of the cut fronds. Cut bolts can be treated with ultraviolet light for 30 minutes to eliminate fungi and both ends of the date palm frond could be dipped in paraffin, if available, to retain moisture and prolong its duration as rearing substrate. (Keena, 2017).

Figure 6. An adult of *J. hammerschmidtii* emerged from larva fed upon a cut date palm frond base under laboratory conditions

Cerambycid beetle mate at night or late in the day (Linsely, 1959). Male competition for female is often violent, resulting in mutilation, thus, beetles must be mated in single pairs when reared under laboratory conditions. Normally, the eggs of *J. hammerschmidtii* are laid at the base of date palm fronds and in cracks along the trunk, while in captivity it oviposits at the bottom of the container (El-Shafie, 2015). In such a case, the eggs could be collected, transferred to a Petri dish lined with moistened filter and kept for hatching. The collected eggs can be surface sterilize with 70% alcohol, then thoroughly washed three times with distilled water. The newly hatched larvae can then be moved to a cut date palm frond to start the rearing process. As the larvae become pre-pupae, the body segments shorten, with a section near the head becomes translucent and just before pupation they become flaccid (Keena, 2017). These developmental stages are delicate and must be handled carefully. Thus, the movement and disturbance of pre-pupae and pupae should be kept to the minimum to avoid damaging them. Additionally, transferring of pupa will damage the pupal chamber in which it develops to the adult stage (Keena, 2006). Freshly emerged adults (teneral) require several days to sclerotize before emergence. Many adult cerambycids reproduce normally without feeding, while others require feeding for egg maturation and oviposition (Linsely, 1959). In this respect, Al-Saeedi (2019) reported no feeding activities of *J. hammerschmidtii* adults; however, more evidences are needed before declaring this beetle as non-feeder in the adult stage. Possible food sources for adult cerambycids include honeybee pollen, succulent twigs and leaves; 10% honey solution and 30% sucrose solution (Gardiner, 1970).

Conclusion

J. hammerschmidtii can be successfully reared, to adult stage, on cut date palm fronds under laboratory conditions. This rearing protocol can pave the way for understanding the biology and behavior of this serious date palm pest. More trials are needed to for optimizing the protocol and increasing the rearing efficiency.

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