INVESTIGATION OF MATING BEHAVIOR OF RED DATE PALM WEEVIL *RHYNCHOPHORUS FERRUGINOUS* OLIV. (COLEOPTERA: CURCULIONIDAE) UNDER LABORATORY CONDITIONS

HASSAN AL-AYIED

Natural Resources and Environmental Research Institute King Abdulaziz City for Science and Technology P. O. Box 6086, Riyadh 11442, Saudi Arabia

ABSTRACT

Mating behavior of Red Date Palm Weevil *Rhynchophorus ferruginous* Oliv. (Coleoptera: Curculionidae) was investigated on Khalas, Khasab, Sillage and Sukkary date palm cultivars under Laboratory conditions at King Abdulaziz City for Science and Technology, Riyadh, Saudi Arabia. Newly emerged males and females were taken from the above mentioned infested date palm cultivars for two complete generations to eliminate diet maternal effects. Mating behavior was recorded with 1:1, 2:1 and 1:2 male to female ratios for 30 minutes. Results indicated multiple mating with consistent sequence of behaviors including rostral rubbing before antennal tapping during and guarding after mating. Though data revealed significant differences in various mating behavior parameters but did not exhibit a definite trend. There was no significant difference for mating duration among different insect ratios.

INTRODUCTION

Red Date Palm Weevil, Rhynchophorus ferruginous Oliv. is a serous pest of date palm in the Kingdom. The male and female adults are large reddish brown beetles about 30 mm long and with a characteristic long curved rostrum; with strong wings capable of undertaking long flights. Damage to date palm is mainly caused by the larval stage feeding within the trunk of palms. The weevil completes several generations per year inside the same host until the tree collapses (Rajamanickam et al. 1995) and (Avand Faghih 1996).The concealed feeding behavior of the RDPW makes it more difficult to detect infestations at early stages often rotting of the internal tissues leads to the death of the date palm tree (Abraham et al. 1998). The import of date palm offshoots as a planting material played a vital role in rapid distribution of RDPW in the Middle East (Abraham et al. 1998). Its massive increase in population and distribution is now a potential threat

to date producing community. In RDPW infested date palm plantation, the yield was reduced between 0.7 and 10-tonnes per hectare (Gush 1997).

A better understanding of the mating behavior of RDPW is critical for developing sound management strategies. Reproductive behavior is correlated with the condition of the larval host (Hanks 1999). (Nirula 1956) reported that in RDPW mating can take place at any time of the day and duration of the act of copulation varies from 2 to 10minutes. Matings continues throughout the life of the female, until it ceases the oviposition. (Vanderbilt et al. 1998) studied mating of *Rhynchophorus cruentatus* F. in the laboratory and observed a consistent sequence of mating behavior. Male exhibited rostral rubbing and antennal tapping before copulation and guarding females afterwards. The guarding behavior might serve to deter mating attempts by other male in aggregation (Eberhard 1996). Several studies have been made on various biological aspects but very little is known about the mating behavior of this economically important pest. Thus the present study has been design to study the mating behavior of red date palm weevil reared on various date palm cultivars also to evaluate the impact of host plant food quality on mating behavior.

MATERIAL AND METHODS

The experiments were carried out during the year 2003-5 at 2005 Natural Resources and Environmental Research Institute, King Abdulaziz City for Science and Technology, Riyadh, Saudi Arabia.

The weevils were collected as cocoons from infested palms established on Khalas, Khasab, Sillage and Sukkary cultivars collected weevils were reared on different hosts under lab. conditions for two successive generations. The cocoons were placed individually in covered containers (7.00cm diam. × 8.50cm high) having wide mouth (6.5cm diam.) with moistened tissue papers at 25°C until adult emergence. Mating behavior of red date palm weevil was recorded by putting the newly emerged males and females in mating arenas (Pic. 1). The mating arenas (15cm diam. × 3.20cm high) were made by joining two lower parts of Petri dishes lined with a moist filter paper. Three 3-mm diam. holes were also made in the center of upper part for aeration. Mating was recorded for following parameters.

1-Time between male and female weevils introduction in mating arena and actual mating, 2-Mating duration, 3-Mating frequency/30-min., 4-Duration between two mating, 5-No. of successful mating attempts/30-min.

The mating behavior was recorded for newly emerged males and females in single pairs and once using 2-males with one female and than using 2-females with one male in mating arenas. The time for each observation was 30-minutes. Each observation was repeated six times. The time was recorded with ordinary stop watch. All these studies were conducted at room temperature 26 ± 2 °C.

The data were analyzed for significant difference using Fisher least significant difference (LSD) (SAS 2003).

RESULTS AND DISCUSSION

Results indicated multiple mating (Pic. 2) with consistent sequence of behaviors including rostral rubbing before antennal tapping during and guarding (Pic. 5) after mating. An identical behavior has been observed in Rhynchophorus cruentatus F. (Vanderbilt et al. 1998) and Ips beetle (Brich 1978) where rostral rubbing and antennal tapping were considered as a placating gesture while guarding behavior serve to deter matting attempts by other males. Female remained very still in all mating attempts and readily accepted each mate. In M1:F2 and M2:F1 ratios while mating other male or female tried to separate the mating pair with rostrum (Pic. 3-4). Males also attempted to mate with other males in M2:F1 ratio as reported by (Vanderbilt et al. 1998) in Rhynchophorus cruentatus F.

The results showed significant differences in various mating behavior parameters but did not exhibit a definite trend. Significantly more mate recognition time was recorded on Sukkary while minimum on Khasab cultivars. The mate recognition time ranged between 3.44 – 6.23min. There was no significant difference for first mating duration but in second and third attempt a significant difference has been observed between different cultivars. Moreover, it is evident that mating duration successively decreased from first to third mating attempt in almost every date palm cultivars. Average mating duration ranged between 0.87 – 2.53 min. Minimum average duration between first two mating attempts was recorded on sukkary while maximum on Sillage which could not sustained for duration between second and third mating attempts where minimum duration was observed on sillage while maximum on Khasab cultivar. The average duration between the successive matings ranged between 3.33 – 6.77 min. but duration between successive matings was reduced. Although, there was no significant difference in average mating frequency among Khalas, Khasab and Sillage cultivars as well as among Khalas, Khasab and Sukkary cultivars but red date palm weevils reared on sukkary showed

higher mating frequency (Tab. 1). The M1:F1 insect ratio took significantly more time in mate recognition as compared to M1:F2 and M2:F1 ratios which remained statistically at par with each other. This indicated that in aggregation RDPW males get quick mating stimulation and verify the observations of (Vanderbilt et al. 1998) that males of Rhynchophorus cruentatus F. highly stimulated to mate in aggregation. Also, there was no significant difference for mating duration among different insect ratios. The average mating duration ranged between 1- 2.21-minute. A higher interval between two mating was recorded in M1:F1 insect ratio which remained statistically similar to M2:F1 but different from M1:F2. The difference in mating frequency was not significant between M1:F2 and M2:F1 ratio but was significant from M1:F1 ratio at 5% level of confidence (Tab. 2). Results indicated higher average mating frequency with F2:M1 which required further investigation by increasing number of females.

TABLE (I)

Mating behavior among weevils reared or collected from different host palms in Riyadh region during 2003-2005.

Cultivars	TMR	MD1	MD2	MD3	DBM1-2	DBM2-3	MF
Khalas	4.46ab	1.65a	1.52b	1.29ab	5.61ab	4.48ab	3.33ab
Khasab	3.44b	2.50a	1.95ab	1.65a	5.59ab	6.35a	3.29ab
Sillage	6.18a	1.89a	2.53a	0.87b	6.77a	3.33b	2.75b
Sukkary	6.23a	1.90a	1.65ab	1.29ab	4.31b	5.19ab	3.50a

TMR (Mate recognition time), MD1 (First mating duration), MD2 (Second mating duration) MD3 (Third mating duration), DBM1 (Duration between first and second mating episodes), DBM2-3 (Duration between second and third mating episodes) and MF (Mating frequency).

TABLE (II)

Effect of different sex ratio on the mating behavioral events of red palm weevil under lab. conditions during 2003-2005.

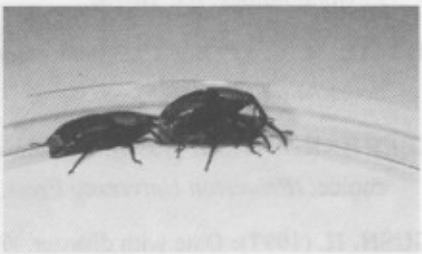
Sex Ratio	TMR	MD1	MD2	MD3	DBM1-2	DBM2-3	MF
M1:F1	6.31a	1.64a	1.87a	1.00a	6.75a	5.57a	2.81b
M2:F1	4.20b	2.21a	2.08a	1.46a	5.27ab	5.50ab	3.38ab
M1:F2	4.72b	2.11a	1.79a	1.36a	4.69b	3.45b	3.47a

M1: F1 (Single pair), M2: F1 (Two males and one female) and M1:F2 (one male and two females).

Conclusions: RDPW presented multiple mating with consistent sequence of behavior. Weevils raised on Khasab took short mate recognition time with longer mating duration. Whereas, mating frequency remained higher in sukkary with short

gape between copulatory events. Weevils in aggregation presented quick mate recognition with higher mating frequency. Mating behavior initiated more quickly with M2:F1 but mating frequency remained higher with M1:F2 while mating duration showed no significant difference. Further study is required with increased number of males and females for more precise evaluation of mating behavior in aggregation.

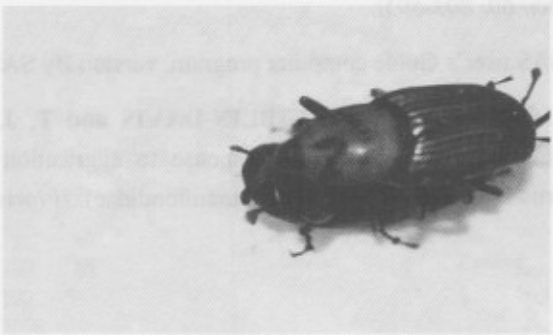
Pic. 1. Mating arena



Pic. 2. During mating

Pic. 3. The male is trying to dislodge the mating male.

Pic. 4. The female is trying to dislodge the mating male.



Pic. 5. Guarding behavior

REFERECES

ABRAHAM, V. A.; M. A. AL-SHUAIBI; J. R. FALEIRO; R. A. ABUZUHAIRAH and P. S. P. V. VIDYASAGAR (1998): An integrated management approach for red date palm weevil, Rhynchophorus ferrugineus

Oliv., a key pest of date palm in Middle East. *(Sultan Qabus University Journal for Scientific Research, Agricultural Sciences 3: 77-84).*

AVAND FAGHIH, A. (1996): The biology of red date palm weevil. Rhynchophorus ferrugineus Oliv. (Coleoptera, Curculionidae) in Saravan region (Sistan and Balouchistan Province, Iran). *(Applied Entomology and Phytopathology. 63: 16-18).*

BRICH, M. C. (1978): Chemical communication in pine bard beetles. *(American Scientist 66: 409 - 419).*

EBERHARD, W. G. (1996): Female control: Sexual selection by cryptic female choice. *(Princeton University Press, Princeton, NJ).*

GUSH, H. (1997): Date with disaster. *(The Gulf Today, September 29, pp.16).*

HANKS, L. M. (1999): Influence of the larval host plant on reproductive strategies of cerambycid beetles. *(Annu. Rev. Entomol. 44: 483–505).*

NIRULa, K. K. (1956): Investigation on the Pest of Coconut Palm. *(Part. IV. Rhynchophorus ferrugineus F. Indian Cocon. J. 9: 229-247).*

RAJAMANICKAM, K.; J. S. KENNEDY and A. CHRISTOPHER (1995): Certain components of integrated management for red palm weevil, Rhynchophorus ferrugineus F. (Coleoptera. Curculionidae) on coconut. *(Mededelingen Faculteit Landnouwkundige en Toegepaste Biologische Wetenschappen 60: 803-805).*

SAS, I. (2003): SAS user's Guide computer program, version By SAS, I.

VANDERBILT, C. F.; M. ROBIN; GIBLIN-DAVIS and T. J. WEISSLING (1998): Mating behavior and sexual response to aggrication pheromone of Rhynchophorus cruentatus (Coleoptera: Curculiondidae). *(Florida Entomol. 81: 351-360).*