*J. Plant Prot. and Path., Mansoura Univ., Vol.5 (5): 573-578, 2014*

# THE PREDACEOUS EFFICIENCY OF *Labidura riparia* PALLAS REARED ON RED PALM WEEVIL, *Rhynchophorus ferrugineus* (OLIVIER), IMMATURE STAGES (COLEOPTERA: CURCULIONIDAE)

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## ABSTRACT

Laboratory experiments were carried out in order to evaluate the predaceous efficiency of the earwig, *Labidura riparia* Pallas against the red palm weevil (RPW), *Rhynchophorus ferrugineus* immature stages. Obtained results showed that the 6th nymphal instar of *L. riparia* was the most predacious stage on all RPW immature stages. However, the 1st nymphal stage of *L. riparia* had the least predacious rate on all RPW immature stages. In addition, results showed that all immature stages of RPW were preferred for consumption by the earwig nymphs. The rate of consumption of immature stages of the RPW was increased by the age of the nymphal stage. Results showed that the 6th instar nymphs had the longest feeding duration upon all immature stages of RPW. Finally, the earwig, *L. riparia*, can be considered as a promising natural enemy to minimize the red palm weevil population density.

**Keywords:** Red palm weevil, *Labidura riparia*, laboratory experiments, predaceous efficiency.

## INTRODUCTION

The date palm and the date fruits are hosts for many insects and diseases which are seriously enough to inflict heavy losses if left without control. Under traditional date palm culture, the growers were helpless and in some cases they were unable to identify the causal organism. Date palm insect pests, in general, and the red palm weevil (RPW), *Rhynchophorus ferrugineus* (Olivier) (Coleoptera: Curculionidae), in particular, are widely accepted as being the most destructive factors of date, coconut and oil palms throughout South and Southeast Asia (Wattanapongsiri, 1966). Nowadays, the date palm crop in Eastern Arab countries is under threat. Red palm weevil was probably introduced to the Middle East on infested ornamental palm from India or Pakistan. Red palm weevil was firstly discovered attacking palm in the Arabian peninsula especially United Emirates at 1986 and progressively spread to Gulf states and crossed the red sea into North Africa as the latest record since 1992 in Egypt. It is found over a wide geographical area in Asia, involving many different agro ecosystems. The related species is highly polyphagous with number of known hosts exceeding more than ten different palm species (Murphy and Briscoe, 1999). Effective methods for control this

pest has been difficult to develop. During the last two decades all efforts to control *R. ferrugineus* in the Arab countries, focused on the use of traditional insecticides, modified cultural practices and recently pheromone traps (Abraham *et al*., 1998). Despite the intensive efforts and the high costs of controlling RPW, it is continuously spreading everywhere and destroying the holy date palm tree. Management programs of RPW depend mainly on chemical insecticides (Girgis *et al*., 2002). About 900 species of earwigs are identified worldwide, most of them being tropical. Earwigs are active predaceous of tiny insects, besides feed on living and dead plants of the same ecosystem. They are considered important predators of eggs, larvae and pupae of moths and beetles (El-Hussieni, 1969). The Indian earwig, *Labidura riparia* Pallas, is the dominant species and mainly preys cutworms, caterpillars, small grubs, maggots, mealybugs, fleas and other insects (Dugard, 2006). In Brazil, *Euborellia annulipes* (Lucas) and *L. riparia* were associated with commercial poultry ranches as biological control agents (Guimaraes *et al*., 1992). In the USA, *L. riparia*, was recorded as a predator of pupal stage of lepidopterous pests in soybean fields (Domiciano and Herzog, 1990 and Lee *et al*., 1990), and was the most abundant predator in peanut fields (Kharboutli and Mack, 1991); in Germany, as predator of tomato pests (Probst *et al*., 1999); in Spain, as a predator of maize aphid (Asin and Pons, 1998). On the other hand, Johri and Reeta (1996), in India, observed that *L. riparia* form bengalensis (Dohrn) was omnivorous and the adults damaged 10.4-21% of stored potato tubers. In, Egypt, *L. riparia* was recorded affecting the changes in the population densities of *Thrips tabaci* Lind., *Empoasca* sp. and *Compylomma* spp. in corn fields (Ahmed and Darwish, 1991); *Bemisia tabaci* Gennadius in cotton fields (Darwish and Farghal, 1990); *Phthorimaea operculella* Zeller in tomato and potato fields (Abbas *et al*., 1993) and *Aphis craccivora* Koch. in faba bean fields (El-Defrawi *et al*., 2000). However, scanty attention has been paid to use the earwig as a biological control agent for the RPW immature stages. Accordingly, we aimed to examine the predacious efficiency of *L. riparia* for controlling the red palm weevil immature stages.

## MATERIALS AND METHODS

**1. Rearing technique of red palm weevil, *Rhynchophorus ferrugineus*:**

Adults of red palm weevil, *Rhynchophorus ferrugineus* (Olivier), were collected from the fields which cultivated with date palm trees located at El-Katta, Giza Governorate. Plastic boxes were prepared (40 x20x15 cm) covered with muslin cloth for aeration, provided with small pieces of sugarcane stem. Each box contained 20♀+10♂. Newly hatched larvae were collected daily by pieces of sugarcane introduced to larvae for feeding. The last larval instar prior to pupation was placed in plastic boxes as mentioned above with palm pests. In addition, of large piece of sugarcane was used to help in forming the cocoons. Cocoons were collected, kept in bigger plastic boxes and supplied with wet filter paper. The obtained cocoons were daily inspected and emerged adults were collected and sexed soon after emergence. Paired adults placed in separate cups and provided with slices of sugarcane stem as ovipositional sites.

**2. Rearing of the earwig, *Labidura riparia*:**

Newly collected earwigs were reared on *Spodoptera littoralis* Boisduval larvae. Insects were kept in cylindrical plastic containers measuring 12cm. in diameter and 7cm. high containing 5cm. layer of moisturized sand. The containers were covered with halves of Petri dishes or with pieces of cloth fitted in position by rubber bands. For studying the biological processes, the individuals of earwigs were kept between two glass-plates that slipped in a woodier frame (20x20cm.), leaving a space of 1.5cm. between them. This space was filled with moistened sand to a level of 15cm. of the erected side, leaving the rest of the space for the free movement of the insects. Biological processes, such as mating, oviposition, maternal care, etc. were easily followed through the glass plates. Nymphs were reared individually in 9 cm. Petri dishes; a moistened filter paper was placed on the bottom of the dish and a piece of polyethylene under the lid. Number of laid eggs per female was determined by confining couples of recently emerged adults in deep Petri (EL-Hussini, 1969). All earwig individuals were reared and incubated under laboratory conditions at 25±1° C and 70±5 % R.H. where daily inspection and renewal of preys was carried out.

**3. Data analysis:**

Means were tested for significance by the one way analysis of variance (ANOVA) using Costat statistics 6.0, release 6.303 software. When the ANOVA statistics were significant at ($P \leq 0.01$), means were compared by the Duncan's multiple range test using Costat statistics 6.0.

## RESULTS AND DISCUSSION

Data presented in Table (1) showed the predative efficacy of nymphal stages of *L. riparia*. The 6th nymphal stage was the most predacious stage. The mean number of consumed immature stages of RPW was 349.33± 34.90, 351.33± 34.54, 340.67± 33.34, and 363.67± 36.67, respectively. Coming in the second place was the 5th nymphal instar, followed by 4th and 3rd nymphal instar. The 1st and 2nd nymphal instars of *L. riparia* were the least consuming instars.

Results also showed that the 1st and 3rd larval instars of the RPW were the most preferable for consuming by the earwig 1st, 2nd, and 6th nymphal instars. However, the 2nd, 3rd, 4th, and 5th nymphal instar preferred the RPW eggs for consumption (Table 1).

**Table (1): Mean numbers of red palm weevil immature stages consumed by nymphal stage of *Labidura riparia* under laboratory conditions**

| Nymphal instars | Consumed red palm weevil stages (mean ± S. E.) | | | |
|---|---|---|---|---|
| | Eggs | 1st larval instar | 2nd larval instar | 3rd larval instar |
| 1st instar | 93.67±18.45[a] | 96.00±15.7[a] | 85.33±12.33[b] | 80.33±13.30[c] |
| 2nd instar | 167.67±20.90[a] | 155.00±16.87[b] | 155.33±14.78[b] | 155.33±14.78[b] |
| 3rd instar | 219.67±25.8[a] | 214.33±22.88[a] | 174.00±16.67[b] | 171.00±16.01[b] |
| 4th instar | 253.33±33.3[a] | 149.00±10.33[b] | 152.00±15.78[b] | 115.33±11.25[c] |
| 5th instar | 332.67±33.33[a] | 331.00±32.03[a] | 323.67±30.67a | 273.33±25.33[b] |
| 6th instar | 349.33±34.90[a] | 351.33±34.54[a] | 340.67±33.34[a] | 363.67±36.67[a] |

**Table (2): Mean feeding duration of different nymphal stages of *Labidura riparia* on immature stage of red palm weevil under laboratory conditions**

| Nymphal instars | Duration (Days) (mean ± S. E.) | | | |
|---|---|---|---|---|
| | Eggs | 1st larval instar | 2nd larval instar | 3rd larval instar |
| 1st instar | 15.43 ± 1.48[a] | 15.89 ± 1.91[a] | 12.19 ± 2.09[b] | 11.47 ±1.93[b] |
| 2nd instar | 15.14 ±0.74[a] | 14.03 ±0.72[a] | 12.94 ±1.27[b] | 11.14 ± 0.78[c] |
| 3rd instar | 15.23 ± 0.98[a] | 14.30 ±1.71[a] | 12.11 ± 2.04[b] | 11.08 ± 1.09[c] |
| 4th instar | 16.55 ± 1.48[a] | 15.03 ± 0.64[a] | 13.33 ± 2.01[b] | 12.22 ± 0.99[b] |
| 5th instar | 22.33 ± 1.98[a] | 17.89 ± 2.01[a] | 14.30 ± 1.22[b] | 13.00 ± 0.4[b] |
| 6th instar | 25.49 ± 1.94[b] | 30.33 ± 0.77[a] | 28.89 ± 0.99[a] | 31.13 ± 2.06[a] |

Data in Table (2) showed the mean duration of different nymphal stages of *L. riparia* fed on immature stages of red palm weevil. The 6th instar had the longest feeding duration upon all immature stages of RPW. The earwig nymphs consumed RPW eggs for 25.49 ± 1.94 days, 1st instar larvae for 30.33 ± 0.77, 2nd instar larvae for 28.89 ± 0.99, and 31.13 ± 2.06 days on the 3rd instar larvae. followed by 5th nymphal instar consumed (22.33±1.98[a] eggs, 17.89±2.01[a] 1st larval instar,14.30±1.22[b] 2nd larval instar and 13.00± 0.4[b] 3rd larval instar, 4th nymphal instar consumed (16.55±1.48[a] eggs, 15.03± 0.64[a] 1st larval instar,13.33±2.01[b] 2nd larval instar and 12.22±0.99[b] 3rd larval instar ), 3rd nymphal instar 15.23±0.98[a] eggs,14.30±1.71[a] 1st larval instar, 12.11±2.04[b] 2nd larval instar and 11.08±1.09[c] 3rd larval instar, 2nd nymphal instar 15.14±0.74[a] eggs ,14.03±0.72[a] 1st larval instar,12.94±1.27[b] 2nd larval instar and 11.14 ±0.78[c]3rd larval instar and the 1st nymphal instar (15.43±1.48[a] eggs, 15.89±1.91[a] 1st larval instar 12.19±2.09[b] 2nd larval instar and 11.47± 1.93[b]3rd larval instar.

Generally, it was observed that the 6th nymphal instar *Labidura riparia* of can survive for 31.13 days when fed on the 3rd larval instar of RPW red palm weevil under laboratory conditions. 25 °C±2 & Rh 70% ±5%Results were consistent with Kharboutli and Mack (1993) who found that *L. riparia* consumed more larvae of *Spodoptera frugiperda* (Smith) at 30 °C. Furthermore, the obtained results agreed with Bassal *et al*. (2001) who found that the rate of consumption of earwig nymphs increased by nymphal instar. In addition, Abd-Elgayed and Owayss (2007) in full agreement with our results. So, in conclusion, the earwig, *Labidura riparia*, as a predator, can be considered as a promising natural enemy to minimize the red palm weevil population density.

**Table (3): Nymphal duration of *Labidura riparia* fed on different immature stages of RPW.**

| Nymphal instars | Eggs | 1st larval instar | 2nd larval instar | 3rd larval instar |
|---|---|---|---|---|
| 1st instar | 6 ± 1 | 6.5 ± 0.5 | 4.5 ± 0.5 | 4±1 |
| 2nd instar | 11± 2 | 10.5 ±1.5 | 10.5 ± 2.5 | 11.5 ± 2.5 |
| 3rd instar | 11± 2 | 13.5 ± 0.5 | 10.5±0.5 | 14.5 ± 0.5 |
| 4th instar | 9 ± 0.5 | 12.5 ± 0.5 | 13±1 | 12.5 ± 2.5 |
| 5th instar | 11.5 ± 0.5 | 13.5± 1.5 | 11± 1 | 13 ± 2 |
| 6th instar | 14.5 ± 0.5 | 14 ±1 | 13.5 ± 0.5 | 10.5 ± 0.5 |

Nymphal duration of *Labidura riparia* fed on eggs was (70.5days) following by 1st instar larvae of RPW (66 days), the 2nd instar larvae (63days) and 3rd instar larvae (63 days).

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**الكفاءة الافتراسية لإبرة العجوز الكبيرة *Labidura riparia* المرباةعلى الاطوار الغير الكاملة لسوسة النخيل الحمراء**

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تم إجراء الدراسة الحالية معمليا لتقييم كفاءة النشاط الافتراسى لابرة العجوز ضد الأطوار الغير كاملة لسوسة النخيل الحمراء. أظهرت النتائج المتحصل عليها أن الحوريات فى العمر السادس لابرة العجوز كان الأكثر افتراساً للأطوار الغير كاملة. وكان أقلهم افتراسا هو العمر الحورى الأول لابرة العجوز وأقل معدل افتراس. أوضحت النتائج أن معدل الافتراس لأطوار الغير كاملة لسوسة النخيل تزيد بزيادة العمر الحورى لابرة العجوز. كما أوضحت النتائج أيضاً أن العمر الحورى السادس استغرق أطول مدة افتراس على الأطوار الغير كاملة لسوسة النخيل. تعتبر ابرة العجوز عدو طبيعى واعد فى تقليل أعداد سوسة النخيل الحمراء.