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**The Thesis Submitted for Ph.D Degree in the Plant protection**

**Study of biology parameters ladybird *Exochomus nigripennis* by  
feeding on *Gossyparia spuria* under laboratory conditions and  
determination of its distribution pattern using GIS in Yazd  
province**

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## Abstract

The biological parameters of ladybird *Exochomus nigripennis* after feeding on *Gossyparia spuria* was investigated under laboratory conditions. The average of growth rate from egg from to adult in different temperatures of 23, 27, 31 and 35°C after feeding on *G. spuria* were  $49.0 \pm 1.7$ ,  $32.7 \pm 0.8$ ,  $24.6 \pm 0.3$  and  $22.5 \pm 0.5$  days, respectively. The results showed that developmental period decreased with increasing temperature. The lowest mortality was observed at 31°C. The results showed that 31°C was the optimal temperature for development of these ladybirds. Based on the linear model, the low-temperature thresholds for eggs, larval, pupal and egg to adult stages after feeding on *G. spuria* were 12.77, 14.77, 12.88 and 13.65°C, respectively. The amounts of thermal constant for the eggs, larval and pupal stages were 78.81, 256.89, 78.73 and 450.89 days, respectively. Two-sex life table parameters of *E. nigripennis* after feeding on *G. spuria*, *Agonoscena pistaciae* and *Ephestia kuehniella* were investigated. The intrinsic rate of increase ( $r_m$ ) were 0.092, 0.078 and 0.095 (female/female/day) and finite rate of increase ( $\lambda$ ) were 1.09, 1.08 and 1.11 (female/day), respectively; the higher value of the intrinsic rate of the increase relates to the more suitability of the diet for the population growth and this suggests that *E. kuehniella* egg was the most favorable diet for mass rearing of *E. nigripennis*. Predation rates of adults' male and female were 1691 and 2433, respectively. SAS statistical logistic regression was used to determine the type of the functional response and the nonlinear regression to estimate the parameters of searching efficiency ( $a$ ) and handling time ( $T_h$ ). The results showed that the type of the functional response at different temperatures and all age stages of the predator were the type II, except at 35°C and fourth larvae stage that was the type III. In the study of *E. nigripennis* distribution areas using GIS in Yazd province, nearly 26.94% of the province's areas are completely suitable for releasing these ladybird in term of temperature potential, humidity level, rainfall rate, height and amount. Therefore, temperature with a final weight of 0.529 is the most important factor influencing the release of ladybirds. One of the important pests of elm trees in the greenspace of Yazd province is *G. spuria*, which has not remarkably economic damage in the past, but with widespread cultivation and climate change, it has strongly flooded and included a serious threat to the greenspace of Yazd province. For this reason, the biology of this pest was investigated. It is shown in the population change a chart that the highest density of different growth stages of *G. spuria* was observed in the northward direction. Overwintering nymphs woke up whenever winter warmed in late February. The emergence of the males was started by creating a cocoon around age of second nymphs and they became pre-pupae and pupae; the more males were exited from the pupal cocoon. The males of this scale appeared in both winged and wingless forms. The activity of female over-winter nymphs began after male nymphs. Peak of female populations in most areas was observed in mid-April. The females laid eggs in white wax that covered around their bodies. After that, first instar nymphs hatching remained slightly waxed and settled on the underside of the leaf and fed from sap. The first instar nymphs were transformed into the second instar nymphs and the beginning of autumn, also the deceleration of the sap and become yellow color of leaves. They moved from the leaves to the branches and on the rough surfaces of branches were integrated around the buds of the plant and prepared for wintering.

**Keywords:** Biology, Coccid, Functional response, GIS, Ladybird, Life table, Predatory rate.