BENEFITS OF EGG CLUSTERS IN THE EVOLUTION OF LARVAL AGGREGATION IN THE NEOTROPICAL BUTTERFLY ASCIA MONUSTE ORSEIS: REDUCTION OF EGG FAILURE AND ENHANCED LARVAL HATCHING

Additional key words: decision making, oviposition, hatching, cannibalism

The number of species of phytophagous lepidopterans that aggregate eggs during oviposition indicates that this behavior is rare in nature when compared to those laying single eggs: in North America, only 4.7% of species aggregate eggs (Stamp 1980). Egg clutch size is an important component of these species’ life history because it reduces predation risk of newly hatched larvae (Stamp & Bowers 1988, Lawrence 1990) and maintains adequate temperature and relative humidity for proper egg (Clark & Faeth 1998) and larvae development (Stamp 1980, Willmer 1980). In addition, the egg desiccation hypothesis (Stamp 1980, Clark & Faeth 1998) proposes that aggregation of eggs is adaptive per se because it decreases mortality through increasing larval hatching success.

Cannibalism is described as an important component of behavior in A. monuste orseis larval aggregations in the laboratory (Zago-Braga & Zucoloto 2004, Santana et al. 2011) and in the field (Barros-Bellanda & Zucoloto 2005). Despite the associated costs and benefits related to egg aggregation in this species—like biomass gain (Barros-Bellanda & Zucoloto 2001) and removal of potential competitors (Zago-Braga & Zucoloto 2004)—some implications for this behavior have yet to be identified. It has been shown, for example, that egg cannibalism may reduce reproductive potential (Fordyce 2005) for the parental female. Egg clustering can be a risky behavior for the parental female as well as for the deposited eggs. In fact, A. monuste orseis females avoid ovipositing on plants with conspecific larvae (Barros-Bellanda & Zucoloto 2005), because older caterpillars can cannibalize eggs (Zago-Braga & Zucoloto 2004, Barros-Bellanda & Zucoloto 2005). On the other hand, egg mortality in nature also happens due to factors like desiccation when abiotic conditions are variable or suboptimal.

Most hypotheses related to the adaptive significance of egg aggregation focus on the consequences observed in larvae, especially in first instars, when they show higher mortality (Stamp 1980, Kagata & Ohgushi 2002, Zalucki et al. 2002). As every larval aggregation is a result of an egg clutch in phytophagous insects (Stamp 1980), we aimed to evaluate whether there is a variation in the vulnerability of egg clutches of different sizes, based on egg cannibalism and egg failure data. It is hypothesized that eggs in larger clutches are more resistant to environmental effects and would show higher hatching rates than eggs in smaller clutches.

Ascia monuste orseis eggs were collected from kale (Brassica oleracea L. var. acephala D.C.) leaves in a pesticide-free garden, situated in the Biology Department of Faculdade de Filosofia, Ciencias e Letras de Ribeirao Preto, USP (FFCLRP / USP) (21°05’S, 47°50’W), Brazil. Leaves with eggs were taken to the laboratory and kept in glass jars (12 cm high × 8 cm diameter) to maintain leaf freshness until larval hatching. Newly hatched caterpillars were placed in plastic boxes (10 × 10 × 4 cm) and were fed with fresh kale taken from the host plant. Leaves were offered ad libitum and replaced daily. Boxes were kept in a climate-controlled chamber ELETROLAB® (93,5 × 50 × 51 cm): temperature: 29±1ºC, humidity: 75% e photoperiod: 10 light: 14 dark (Barros-Bellanda & Zucoloto 2005, Santana & Zucoloto 2011).

Twenty-four hours after hatching, a butterfly pair, raised in controlled abiotic conditions during the larval period, was placed in an aluminum cage, covered with white tulle, for reproduction. The cage was in an external greenhouse under semi-natural conditions, excluding predators and rain. Kale plants, that were approximately 2 months old, measuring 50 cm high and grown in the same substrate, were available for ovipositions and a liquid diet of water and sugar (3:1). The plants were replaced every couple of days. Plants were also checked daily for the presence of eggs; once detected, eggs were separated for observation. Plants with eggs were also kept in the greenhouse under the same conditions.

As females deposited different numbers of eggs, we categorized the clutch sizes as: small (1–9 eggs); intermediate (10–19) and large (more than 20 eggs), according to the frequency of ovipositions distribution (data not shown). Average numbers of hatched larvae from small, intermediate and large clutches were 2.1, 11.5 and 22.6, respectively. Number of deposited eggs, failed eggs and the number of hatched larvae were recorded. Larvae fed from the same plant in which oviposition occurred. There was no manipulation of egg or larvae number to form treatment groups; the natural variation deposited by the female was maintained. The