EFFECTS OF PARENTAL AGE AT OVIPosition ON PROGENY OF CHRYSOPA RUFLABRIS

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ABSTRACT

The effect of age of parent Chrysopa rufilabris Burmeister on progeny mortality was investigated at a photoperiod of 14L: 10D and 26°C. Both adults and larvae were reared on pupae of Tribolium castaneum (Herbst). The oviposition period was divided into 3 equal parts and the mortality and development of progeny from each part were compared. The percentage of infertile eggs laid in the first third of the parent oviposition period was significantly less than in the last two thirds. Percentage of offspring that reached maturity decreased significantly as parental age at the time of oviposition increased. Development time of all progeny also increased as the age of the parent at oviposition increased.

We must thoroughly understand the ecologies and population dynamics of beneficial insects before we can effectively manipulate them on cultivated crops. There is need for greater understanding of factors that affect the size of beneficial insect populations. Some of these factors such as availability of prey and suitability of weather conditions are well known; others, such as the pattern of parental oviposition are more subtle but could be of equal importance.

In the eastern U. S., Chrysopa rufilabris Burmeister is a common predator that shows promise for manipulation on cultivated crops. In a study on the effect of larval diet on this lacewing, Hydorn (1971) found that the pattern of oviposition was affected by larval diet and temperature. As an example, lacewings reared at 22.5±2°C tended to lay a greater number of eggs per day for far fewer days than did lacewings reared from the same diet at 26.0±2°C. To investigate the effect of age of parent at oviposition on progeny mortality, representative samples of all eggs laid by a group of adults were tested for viability and percent reaching maturity.

Much has been written on the influence of parental age on survival and longevity of offspring but since this has been recently reviewed (Clark and Rockstein 1964, Howe 1967) a complete coverage of the literature will not be attempted here. There are, however, certain aspects of previous research that should be mentioned. The variety of insects investigated has been limited. Most research on the effect of parental age has been on stored grain insects, on Drosophila melanogaster Meigen, and on the house fly, Musca domestica Linnaeus. A few papers have been published on age effects in other insects such as Nezara viridula (Linnaeus) (Kiritani 1963), on Oncopeltus fasciatus (Dallas) (Richards and Koldarie 1957), and on the body louse, Pediculus humanus humanus Linnaeus (Flemings and Ludwig 1964). Very few entomophagous arthropods have been studied in this regard. Simmonds (1948), however, discussed the correlation of parental age.

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TABLE 1. RELATIONSHIP BETWEEN AGE OF C. rufilabris ADULTS AT OVIPSIO- 
TION AND TOTAL LARVAL AND PUPAL DEVELOPMENT TIME OF 
PROGENY REARED ON T. castaneum AT 26±2°C.

<table>
<thead>
<tr>
<th>Progeny from:</th>
<th>Av. larval and pupal development time (days)*, **</th>
<th>Range (days)</th>
<th>No. lacewings tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>First 10 days of oviposition</td>
<td>23.3±0.3</td>
<td>21–26</td>
<td>27</td>
</tr>
<tr>
<td>Second 10 days of oviposition</td>
<td>24.4±0.2</td>
<td>22–26</td>
<td>28</td>
</tr>
<tr>
<td>Third 10 days of oviposition</td>
<td>26.0±0.3</td>
<td>25–28</td>
<td>23</td>
</tr>
</tbody>
</table>

* Mean ± Standard Error of mean.  
**All values are significantly different from each other at the 5% level.

with the percentage of offspring of 2 hymenopterous parasites that entered diapause. He also dealt with the effect of age of parent on the longevity and mortality of immatures.

Several researchers have noted that viability of eggs fell with the age of the parent except for a short period at the beginning of oviposition (Robertson and Sang 1941, Richards and Kolderie 1957, Parsons 1962). Ludwig and Fiore (1960) in their investigation of Tenebrio molitor Linnaeus found only the decline of hatching as the parent increased in age. Little research has been done on the correlation between age of parents and mortality of immatures. Results of investigations on parental age and longevity of adult offspring, such as that by Callahan (1962), Tracy (1958), Flemings and Ludwig (1964), Fiore (1960), and Ludwig and Fiore (1961) have been inconsistent. Results of research on the effect of aging on development time of the offspring are even more conflicting. This can be explained to some extent by a difference in techniques. There are so many other factors that affect development time that it is very difficult to say whether an increase or decrease is due to age of parent or to an entirely different factor.

In the present investigation, C. rufilabris adults (P1) were collected in a citrus grove, and their progeny (P1) were reared on pupae and pre-pupae of Tribolium castaneum (Herbst). The lacewings were kept in a controlled light and temperature chamber set for 14 hr light and 10 hr dark, and 26±2°C. Lacewing larvae were kept in the chamber in individual 7-dl plastic vials. The positions of the vials in the chamber were changed daily to ensure uniform temperature. T. castaneum was a relatively dry diet, and moisture inside the vials was supplemented by the addition of water-saturated celluolose squares. The humidity in vials containing first instar larvae was kept above 90% RH. Since the older larvae fared poorly under such humid conditions, most of the water in the celluolose was pressed out before the squares were added to vials containing older larvae. Two days after the second molt the addition of supplementary moisture was curtailed.
To prepare them as food for the lacewings, suitable pupae and pre-pupae of *T. castaneum* were sorted with a brush and then placed in a sieve and rinsed for 2 min in lukewarm water. They were drained and placed in the bottom of the vial. More *T. castaneum* were provided than needed as food (from 7-20 per vial depending on the size of the lacewing). Drowning of young larvae in condensed water was prevented and molting and cocoon spinning of the larvae were eased by pieces of paper toweling placed in the bottom of each vial. Each vial was cleansed and the diet was renewed every other day. All larvae were checked daily, and dates of hatching, cocoon spinning, and death were recorded. Specimens that died were examined by G. Allen (Florida Technological University) for evidence of pathogens.

Sixteen F₁ adults that emerged on 2 successive days were placed upon emergence into a pair of 12-oz plastic cups, one inverted on top of the other and fastened together with tape. The adults were fed equal parts of sucrose and Wheat® with sufficient water to give the mixture a paste-like consistency. This was spread thinly over a small portion of the sides of the top cup, and a few drops of water were sprinkled beside the diet. The bottom cup contained a piece of saturated cellulocotton to increase the humidity inside the container, and a square of dry tissue on which the lacewings could rest. The adults were moved to a new container at 2 day intervals; eggs from the old containers were removed by cutting the egg stalks with small scissors. This procedure was continued until the F₁ adults ceased to lay eggs.

The F₁ adults laid so many eggs during the first two-thirds of their oviposition period that often the eggs were saved only every other time the containers were changed. During the last third of the oviposition period, however, the egg production decreased to the extent that all eggs were

![Graph](image-url)

Fig. 1. Relationship between age of *C. rufilabris* parents at oviposition and viability of eggs at 26 ± 2°C.
Fig. 2. Relationship between age of C. rufilabris parents at oviposition and larval and pupal mortality of offspring reared on T. castaneum at 26 ± 2°C.

sessed. The eggs were placed in individual plastic 7-dr vials and the resulting F₂ larvae were also reared on T. castaneum. Immature mortality and dates of hatching, molting, cocoon spinning, and adult emergence of the F₂ lacewings were recorded. Eggs were said to be infertile if after 5 days they were still the bright green color of newly laid eggs; they were termed "unhatched" if they were fertile but the embryo died before hatching. Where results were statistically analyzed, 2 values were considered significantly different if each was significantly different from the other at the 5% level by Student's t test. Regression analysis was carried out where possible.

RESULTS

The results of the experiment on the effect of parental age at oviposition on mortality of immature progeny are shown in Fig. 1-3. The F₁ adults laid eggs for approximately 30 days. For this study, the oviposition period was divided into 3 equal time units, and the percent mortality within the 3 units was compared.

In Fig. 1, the bars represent the total number of eggs saved for each respective section of the parent oviposition period. The percent hatch of eggs laid in all 3 units differed significantly from each other. Percent hatch of progeny decreased significantly as the parent age at oviposition increased (coefficient of regression = −0.99). The percentage of infertile eggs laid in the first third of the parent oviposition period was significantly less than that laid in the last two-thirds.

In Fig. 2, the bars represent the total number of larvae (used for this
Fig. 3. Relationship between age of C. rufilabris parents at oviposition and total immature mortality of offspring reared on T. castaneum at 26 ± 2°C.

The percentage of total \( F_2 \) offspring (used for this experiment) that reached maturity (Fig. 3) decreased significantly as the parental age at the time of oviposition increased (coefficient of regression = \(-0.98\)).

The results of the experiment on the effect of parental age at oviposition on length of development time of progeny are shown in Table 1. The duration of the egg stage of the progeny was apparently unaffected by the parent age at oviposition. In all cases, the incubation period lasted approximately 4.5 days. The lengths of all post-embryonic developmental stages of progeny appeared, however, to be affected by increased parental age at oviposition.

Development times of all progeny tested that matured are plotted against 2 to 4 day oviposition intervals in Fig. 4. In contrast to data on percentage hatch, the relationship of progeny larval and pupal development time to parental age at oviposition is not a straight line.

**DISCUSSION**

While these results indicate that under the conditions of this experiment, age of parent at oviposition significantly affected both mortality and length of most stadia of progeny, many questions remain unanswered. Is
Fig. 4. Development time of all *C. rufilabris* progeny that matured plotted against 2 to 4 day intervals of parent oviposition period. Immatures reared on *T. castaneum* at 26 ± 2°C.

the decrease in percentage hatch between successive 3rds of the oviposition period due to a decrease in fertilization? Would similar results be obtained if the parents or the offspring had been reared on other larval diets? Preliminary trials indicate this to be the case, but extensive research is needed. Is the low percent mortality and short development time for offspring from eggs laid during the first 10 days due to the age of the parent at oviposition or the fact that they were her first eggs? Studies where oviposition of females is delayed might clarify this point. Since results were gained at a temperature of 26 ± 2°C, would the results be different at higher or lower temperatures, or at the varying temperatures found in the field?

These results have significance with respect to the population dynamics of *C. rufilabris* in the field. Not only is another factor shown to have potential importance in the determination of the size of *C. rufilabris* populations, but this suggests that the mortality of the immatures of other predators may be affected by parental age at oviposition.

**LITERATURE CITED**

Parental Age Effects on Progeny of Chrysopa


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