

Physiological Age-Grading, Ovarian Physiology, and Egg Resorption in the Rice Weevil, *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae)



J. Perez-Mendoza, J. E. Throne, and J. E. Baker



USDA-ARS Grain Marketing and Production Research Center, 1515 College Avenue, Manhattan, KS 66502

INTRODUCTION

- Determination of the age structure of adult insect populations can improve our understanding of the ecology and dynamics of a species, particularly one with overlapping generations.
- Ovarian methods of age determination are based on the degree of parity and the number of completed ovarian cycles. These cycles are determined by the accumulation of follicular relics at the base of the ovariole after oviposition or egg resorption.
- The female reproductive system in *S. oryzae* is of the meroistic/telotrophic type, with a pair of ovaries, each composed of two ovarioles.
- We describe changes in the rice weevil ovarian system as a function of weevil age. We also characterize oocyte resorption induced by starvation of reproductive females. Finally, we present a model for age-grading the female rice weevil based on the degree of ovarian development and follicular relic accumulation.

METHODS

- Mated and virgin females were placed in plastic vials that contained 20 g of uninfested wheat and were allowed to lay eggs for 0, 5, 10, 20, 30, 40, 50, 60, and 70 days. After each time period, females were removed from vials and dissected.
- Ovarian development was assessed by measuring the length of each germarium and the size of the largest terminal follicle at each specific age. In addition, we counted the number of mature and immature oocytes in all four ovarioles and the formation of follicular relics.
- To determine if starvation and subsequent oosorption affected ovarian development and formation of follicular relics, reproductive females were kept with and without food for 0, 24, 48, and 72 h. After each time period, females were dissected.

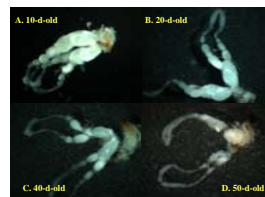


Fig. 1

RESULTS

Morphological Changes in Female Reproductive System

- All females dissected in this study had two ovaries each with two ovarioles. Ovaries from young females contained more eggs than ovaries from older females (Fig. 1).
- Germarium length (Fig. 2A), size of terminal follicle (Fig. 2B), and number of immature (Fig. 2C), and mature eggs (Fig. 2D) differed with age and mating status.

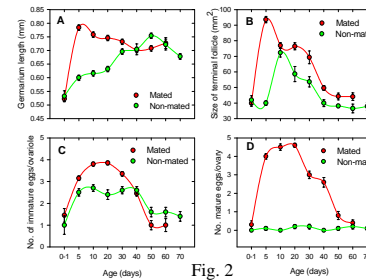


Fig. 2

Effects of Starvation on Oocyte Resorption

- Starvation had an immediate and dramatic impact on the reproductive physiology of weevils (Fig. 3).
- Germarium length (Fig. 4A), size of terminal follicle (Fig. 4B), and the number of immature (Fig. 4C) and mature eggs (Fig. 4D) rapidly decreased, compared with fed females.



Fig. 3

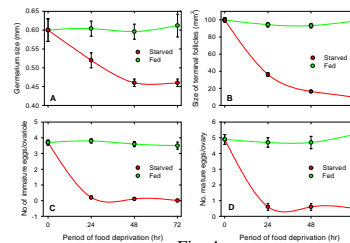


Fig. 4

Physiological Age Grading

- A physiological age-grading system based on that described by Tyndale-Biscoe (1984) was developed. We classified the weevil as having one nulliparous stage (N) and three parous stages (P1, P2, and P3). Parous stage differed with age of weevils and between mated and non-mated females.
- For mated females, follicular relics first became visible after 5 to 10 days (Fig. 5A), whereas follicular relics were not visible in non-mated females until they were 30-d-old (Fig. 5B).

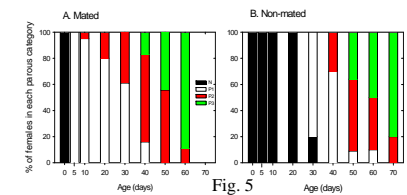


Fig. 5

- The relationship between follicular relic accumulation and age for mated females was: $y = 1.4 + 0.04x$ and for non-mated females was: $y = 0.63 + 0.04x$.
- Confidence limits on predicted ages from each parous stage varied from 21 to 22 d for mated and non-mated females. Thus, one can predict the chronological age of a female in each parous stage with confidence limits of ± 3 weeks using this method.

Progeny Production

- Progeny production varied among parous groups (Fig. 6), suggesting that oocyte development rates also differed and consequently influenced follicular relic accumulation.
- Although overlap occurs, the three parous stages can be distinctly separated by the number of progeny produced.

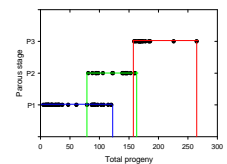


Fig. 6

SUMMARY

The physiological age-grading technique described in this study correlated well with age of *S. oryzae* females, and can provide researchers with a tool to assess the reproductive trend of rice weevil populations in a grain mass.