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Abstract

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Effects of social environments and female life history traits on sex allocation in a spider mite*

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Sex allocation in spider mites (*Tetranychus* sp.) is of interest to many researchers. They are haplodiploid species where the mated females can lay fertile and infertile eggs that develop to daughters and sons, respectively. Females tend to fertilise larger eggs (Macke *et al.* 2011) and adjust the offspring sex ratio under various social environments (e.g., population size and density) (e.g., Weerawansha *et al.* 2022a, 2022b, 2022c). Here, we reported the sex allocation strategy of *T. ludeni* Zacher under nine combinations of three population sizes (1, 5 and 10 ♀) and three population densities (0.67, 1 and 2 ♀/cm^2). We recorded the number of eggs laid by females, measured their size, and identified the sex of resultant adult offspring daily during their early breeding period (1st–5th day). We compared the observed offspring sex ratio (daughters%) with the predictions of theoretical models (i.e., local mate competition models; see details in Weerawansha *et al.* 2022b), and then quantified the effects of social environments, maternal age, and egg number and egg size on sex allocation using a path analysis (see details in Weerawansha *et al.* 2022c). We show that the offspring sex ratio was extremely female-biased (79.4%–86.8%) in different social environments. The predictions of theoretical models (83.3%) only fitted the sex ratios (84.6%–85.0%) observed in a small population (i.e., 1 ♀) with complete inbreeding ($k = 1$), but the observed sex ratio in the larger populations of 5 and 10 ♀ (79.4%–86.8%) was significantly higher than that predicted by the theoretical model (from 55.0% in population size of 5 ♀ when $k = 0$ to 65.7% in population size of 10 ♀ when $k = 0.5$) regardless of population density. We suggest that females produced extremely female-biased sex ratio to reduce the local mate competition between sons in small populations and lower resource competition in large and dense populations. Results of the path analysis show that population size or density alone did not significantly affect offspring sex ratio, but the interaction of population size and density, maternal age, egg number and egg size had significant positive effects on daughter production. Furthermore, the effects of life history traits on *T. ludeni* sex allocation outweighed that of social environments with an order of effect size being: maternal age > egg number > egg size > interaction of population size and density.

Keywords: population size and density, maternal age, egg number and size, sex ratio

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