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Abstract

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Spider mite mothers control their sneaker sons' reproductive behavior depending on operational sex ratio*

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Males often fight with conspecific males for access to females. However, in many species, males may also adopt alternative tactics, such as sneaking or female mimicking, to get access to females by deceiving fighting rival males. Whether a male applies the fighting tactic or an alternative is often determined by its own and the surrounding conditions (conditional strategy). Recent studies revealed that the conditions experienced by parents may also affect their sons' reproductive tactics (Schausberger and Sato 2019). Examining the contribution of both within- and trans-generational influences is important for understanding the evolution of alternative reproductive tactics. *Tetranychus urticae* Koch is a spider mite and a cosmopolitan pest infesting various crops (polyphagous). Male competition for access to females is very intense due to pronounced first-mate sperm precedence. Males show precopulatory mate guarding by mounting teleiochrysalis females and fighter males chase rival males away from the guarded females. Some males apply an alternative reproductive tactic, that is, sneaking behavior (Sato *et al*. 2013). Sneakers do show mounting behavior, just like fighters do, but sit still on the female dorsum and never chase rival males away. They do not fight and are rarely attacked by fighters while mounting. Fighting and sneaking tactics represent a conditional strategy: males tend to display sneaking tactic when young and under high male density which is reflected in the operational sex ratio (OSR; the ratio of fertilizable females to reproductive males) (Sato *et al*. 2014). Spider mite females can control offspring sex ratio to adjust local mate competition (e.g., Macke *et al*. 2012). Therefore, it is expected that mothers can also predict the next-generation OSR that their sons will experience, based on the present OSR. Female-biased OSR in the parental generation should lead to male-biased OSR in the next generation due to offspring sex ratio adjustment, which would improve mating chances of sneaker sons. In this study, to test this idea, we manipulated the OSR that mothers experience during mating and oviposition, and observed the effects on the mating behavior of their sons. We show that maternal OSR did not alter the sneaker proportion among sons, however, sneaker sons from mothers that experienced female-biased OSR started guarding teleiochrysalis females earlier. Early guarding by sneakers may be advantageous for securing mates under intense male competition. We conclude that mothers used the present OSR to adjust their sons' mating behavior to increase their fitness.

Keywords: alternative reproductive tactics, intrasexual selection, male competition, maternal effect, reproductive strategy, transgenerational effects

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