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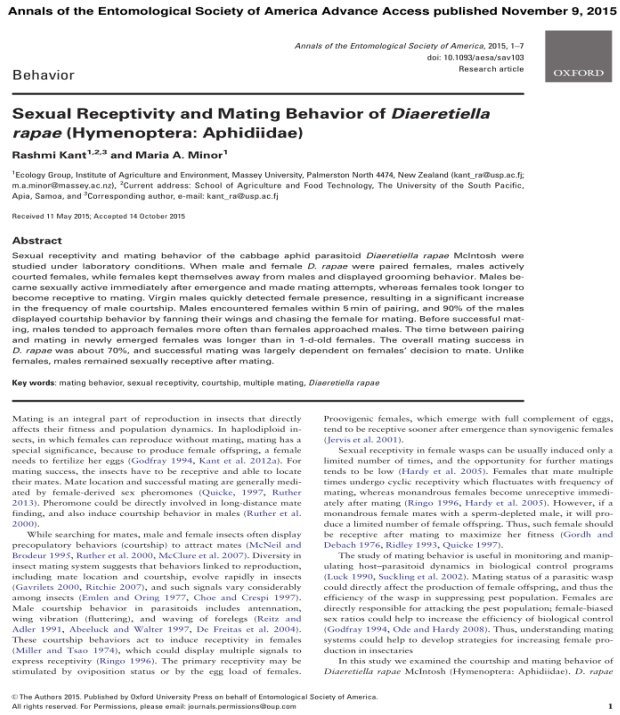

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Research article

Behavior

Sexual Receptivity and Mating Behavior of *Diaeretiella rapae* (Hymenoptera: Aphidiidae)

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Abstract

Sexual receptivity and mating behavior of the cabbage aphid parasitoid *Diaeretiella rapae* McIntosh were studied under laboratory conditions. When male and female *D. rapae* were paired females, males actively courted females, while females kept themselves away from males and displayed grooming behavior. Males became sexually active immediately after emergence and made mating attempts, whereas females took longer to become receptive to mating. Virgin males quickly detected female presence, resulting in a significant increase in the frequency of male courtship. Males encountered females within 5 min of pairing, and 90% of the males displayed courtship behavior by fanning their wings and chasing the female for mating. Before successful mating, males tended to approach females more often than females approached males. The time between pairing and mating in newly emerged females was longer than in 1-d-old females. The overall mating success in *D. rapae* was about 70%, and successful mating was largely dependent on females' decision to mate. Unlike females, males remained sexually receptive after mating.

Key words: mating behavior, sexual receptivity, courtship, multiple mating, *Diaeretiella rapae*

Mating is an integral part of reproduction in insects that directly affects their fitness and population dynamics. In haplodiploid insects, in which females can reproduce without mating, mating has a special significance, because to produce female offspring, a female needs to fertilize her eggs (Godfray 1994, Kant et al. 2012a). For mating success, the insects have to be receptive and able to locate their mates. Mate location and successful mating are generally mediated by female-derived sex pheromones (Quicke, 1997, Ruther 2013). Pheromone could be directly involved in long-distance mate finding, and also induce courtship behavior in males (Ruther et al. 2000).

While searching for mates, male and female insects often display precopulatory behaviors (courtship) to attract mates (McNeil and Brodeur 1995, Ruther et al. 2000, McClure et al. 2007). Diversity in insect mating system suggests that behaviors linked to reproduction, including mate location and courtship, evolve rapidly in insects (Gavrilets 2000, Ritchie 2007), and such signals vary considerably among insects (Emlen and Oring 1977, Choe and Crespi 1997). Male courtship behavior in parasitoids includes antennation, wing vibration (fluttering), and waving of forelegs (Reitz and Adler 1991, Abeeluck and Walter 1997, De Freitas et al. 2004). These courtship behaviors act to induce receptivity in females (Miller and Tsao 1974), which could display multiple signals to express receptivity (Ringo 1996). The primary receptivity may be stimulated by oviposition status or by the egg load of females. Proovigenic females, which emerge with full complement of eggs, tend to be receptive sooner after emergence than synovigenic females (Jervis et al. 2001).

Sexual receptivity in female wasps can be usually induced only a limited number of times, and the opportunity for further matings tends to be low (Hardy et al. 2005). Females that mate multiple times undergo cyclic receptivity which fluctuates with frequency of mating, whereas monandrous females become unreceptive immediately after mating (Ringo 1996, Hardy et al. 2005). However, if a monandrous female mates with a sperm-depleted male, it will produce a limited number of female offspring. Thus, such female should be receptive after mating to maximize her fitness (Gordh and Debach 1976, Ridley 1993, Quicke 1997).

The study of mating behavior is useful in monitoring and manipulating host–parasitoid dynamics in biological control programs (Luck 1990, Suckling et al. 2002). Mating status of a parasitic wasp could directly affect the production of female offspring, and thus the efficiency of the wasp in suppressing pest population. Females are directly responsible for attacking the pest population; female-biased sex ratios could help to increase the efficiency of biological control (Godfray 1994, Ode and Hardy 2008). Thus, understanding mating systems could help to develop strategies for increasing female production in insectaries

In this study we examined the courtship and mating behavior of *Diaeretiella rapae* McIntosh (Hymenoptera: Aphidiidae). *D. rapae*

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