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SHORT NOTE

IMPACT OF MALES ON THE SEX RATIO OF *DIAERETIELLA RAPAE* (MCINTOSH) (HYMENOPTERA : APHIDIIDAE), A PARASITOID OF *LIPAPHIS ERYSIMI* KALT. (HEMIPTERA : APHIDIAE)

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Afroz Z. Abidi, Arvind Kumar and C. P. M. Tripathi (1988) Impact of males on the sex ratio of *Diaeretiella rapae* (McIntosh) (Hymenoptera : Aphidiidae), a parsitoid of *Lipaphis erysimi* Kalt. (Hemiptera : Aphididae). *Bull. Inst. Zool., Academia Sinica* **27**(3): 205-209. The present paper elucidated the impact of males on the sex ratio of female parasitoid, *Diaeretiella rapae.* Male paraitoid interfered with the oviposition ability of female and inhibited the fertilization of ovulating eggs. Results obtained show that for obtaining maximum female progeny, fewer release of female parasitoid would be better.

Key words: *Diaeretiella rapae, Lipaphis erysimi,* Sex ratio, female-male interaction.

The reproductive strategy of parasitoids attacking host instars should be based on optimal conditions for host exploitation (Price, 1973). One way to attain this is the control of sex ratio in response to host cues (Avilla and Albajes, 1984). Regulation of sex ratio of the progeny is an important aspect of arrhenotokous species (Shirota *et al.*, 1983; Kumar and Tripathi, 1987), because it is the female wasp which brings about parasitisation and mortality of the pest (Waage, 1982; Hassell *et al.*, 1983; Kumar and Tripathi, 1987).

Diaeretiella rapae is an important parasitoid of a widely distributed aphid, *Lipaphis erysimi* (Stary and Ghosh, 1983). Mated females can lay both male and female producing eggs (Waage and Ng, 1984; Hoffmann and Kenett, 1985; Kumar and Tripathi, 1987). The sex ratio is an important factor for utilizing this parasitoid in biological control programme (Kfir and Luck, 1979; Waage, 1982; Kumar and Tripathi, 1987), but how male parasitoid interferes with females and affect her sex ratio is not clearly understood. The aim of the present work was to determine the impact of male parasitoid on the sex ratio of female *D. rapae.*

MATERIALS AND METHODS

The parasitoid, *D. rapae* and its host, *L. erysimi* were reared in the laboratory at 18± 5°C and 75±8% RH (Kumar and Tripathi, 1985). Third instar nymphs of the aphids (the stage most preferred by the parasitoid-Singh and Sinha, 1982) were drawn from the maintained culture and were utilized as hosts. One day aged, satiated with 30% honey solution and mated female and fresh male parasitoids (Abidi *et al.*, 1987) were utilized in the experiment.

To study the impact of male parasitoids

on the sex ratio of female *D. rapae*, the experiment was performed in a two-way design [4 parasitoid densities X 2 treatments (with or without males)]. Parasitoids were arranged in two groups. Group 1 contained 1, 2, 4, and 8 female parasitoids while group 2 comprised of the same number of females together with equal number of males.

For the experiment, 4 petri dishes (5× 1.7 cm) were arranged and numbered as 1–4. One hundred aphids (*L. erysimi*) were placed separately on 4 equisized leaves (ca. 3×1.5 cm) of host plant (*Brassica campestris* Linn.). These leaves were than kept individually in numbered petri dishes having moistened filter paper in their bottoms. 1, 2, 4, and 8 female parasitoids were introduced in 1st, 2nd, 3rd, and 4th petri dishes respectively and were allowed to attack hosts for 30 minutes.

The experiments with the 2 group of parasitoids were performed simultaneously like that of the first. Both the treatments were replicated 10 times. After parasitisation, the aphids were reared on *B. campestris* potted plants using the technique of Tripathi and Kumar (1984). The mummies when formed were carefully picked off with fine camel hair brush and were transferred singly into marked sterilized glass vials (2.5×10 cm) with leaf cuttings (to provide moisture to the developing parasitoids-Kumar and Tripathi, 1985). The mouth of the glass vials were kept plugged with absorbent cotton. These mummies were checked daily until the parasitoids emerged. Emergents were counted, sexed, and analysed statistically. Only the number of female parasitoids were taken into account for these calculations (Kfir *et al.*, 1975). The value of sex ratio represents the percentage of females in the population (Mackauer, 1976).

RESUTS

Table 1 shows that with the increase of female parasitoid density the proportion of female progeny decreases significantly. Pressence of male parasitoids significantly lessen the proportion of female progeny. Analysis

TABLE 1

Sex ratio of the parasitoid, *Diaeretiella rapae* at it four density level in the presence and absence of male parasitoid (mean±SD). 100 hosts per trial; 10 replicates per item

Parasitoid density (Females)	Males absent	Males present	χ^2 value for males absent	χ^2 value for males present
1	64.56±6.47	61.32± 7.96	150.06*	141.06*
2	56.39±7.91	50.17± 7.46	126.00*	105.30*
4	51.94±8.56	45.36±10.51	117.00*	105.09*
8	46.78±7.07	41.63±11.56	102.08*	87.36*

* Significant at the level of 0.001.

TABLE 2

Summary of computation for analysis of variance of the data of Table 1

Source of variation	d. f.	Sum of squares	Mean squares	F value	P
Between 2 treatments	1	56.13	56.13	50.12	0.001
Between 4 parasitoid density	3	386.03	128.67	114.88	0.001
Total interaction	3	3.37	1.12		
Total	7	445.53	63.64		

of variance (ANOVA) (Table 2) shows that the number of female offspring was significantly influenced by presence of males ($F=50.12$, $p<0.001$) as well as female parasitoid density ($FF=114.88$, $p<0.001$). A chi square (χ^2) goodness of fit test was significant between the expected and the observed values of sex ratio (Table 1). However, the comparison of the values of sex ratios for *D. rapae* between females alone and females mixed with males resulted in significance at 1% level for all the 4 parasitoid densities (Table 1).

DISCUSSION

The observations reveal that the sex ratio of *D. rapae* is female biased. This is an attribute of a biocontrol agent. The value of sex ratio was maximum on one parasitoid followed by a marked decrease (Kfir and Rosen, 1980). It is due to the lower mortality of male progeny in superparasitized hosts and a decrease in the proportion of diploid eggs laid owing to physical and chemical interference phenomenon (Avilla and Albajes, 1984; Kumar and Tripathi, 1987). The sex ratio was very low when the parasitoid density was increased to eight which might have occurred due to strong mutual interference (Kumar and Tripathi, 1987).

The point of interest is the experimental evidence that male parasitoid interferes with the female ability to reproduce and the hinderance caused by him is either by chasing her for mating (Kfir *et al.*, 1975) and/or by antennal encounters by chance (Kumar *et al.*, 1983). This explanation is very well understood by different values of sex ratio in united sexes.

In addition, the sex ratio of arrhenotokous aphidiids depends upon a number of factors *viz.*, post copulatory period following insemination (Mackauer, 1976), host and parasitoid densities (Ashley and Chambers, 1979), viribility of the males that inseminates the females (Singh and Sinha, 1980), specificity of the parasitoid (Rabasse and Shalaby, 1980), host size (Avilla and Albajes, 1984), temperature (Hoffmann and Kenett, 1985), nutrient sources (Hu *et al.*, 1986), parental age (Hutchinson *et al.*, 1986) and host plants (Kumar and Tripathi, 1987).

The results discussed so far reveal that *D. rapae* can effectively be used against *L. erysimi* by its release, as it has a high female biased sex ratio. The present contribution adds the evidence that male parasitoids affects the ability of females to lay diploid eggs. Further, while constructing the life table of the parasitoid, the effects of the presence of males should be taken into consideration together with other factors which decreases the parasitoid's efficiency.

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雄性蚜蟲寄生蜂 *Diaeretiella repal* (Mcintosh) 對其族羣性比例的影響

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本文闡明雄性之蚜蟲寄生蜂 *Diaeretiella rapae* (McIntosh) 對其雌性性比例之影響。雄性寄生蜂會干擾雌性寄生蜂之產卵能力並抑制卵之受精作用。若欲得最多之雌性子代，結果顯示釋放較少之雌性寄生蜂較好。