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Sex Ratio of *Episyrphus balteatus* (Diptera : Syrphidae) in the Field and Laboratory Population

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Abstract: Adult syrphids (hover flies) are nectar and pollen feeders and most important pollinators in agro-ecosystem while the larval stages are predators on the aphids and are used as bioagent in their biocontrol programme. *Episyrphus balteatus* (De Geer) is the most common and abundant species in northeast Bihar. Hence, its sex ratio was observed under the natural environment (field) and the laboratory conditions. The sex ratio in the field population was observed as male biased (1:1.25) but in the laboratory it was female biased (1: 0.78). The differences between the sex ratio in the field population as well as in the laboratory population are insignificant.

Keywords: Syrphids, *Episyrphus balteatus*, Sex ratio, Aphids, Diptera

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Introduction

Syrphids (Syrphidae: Diptera) are commonly known as hover flies. They are supposed as the strong fliers and good pollinators in agro-ecosystem (Sutherland *et al*., 1999). They are the second most important pollinating agents that play important role in pollination (Mitra *et al*., 2015). They are also supposed as the most important natural enemies of aphids and have high capacity to reduce the population of aphid hosts (Samuel *et al*., 2005; Varshney and Bhist, 2016). Seven species of aphidivorous syrphid predators viz. *Allograpta javana, Asarkina ericetorum, Dideopsis aegrota, Episyrphus balteatus, Ischiodon scutellaris, Melanostoma orientale* and *Paragus serratus* were recorded in northeast Bihar (Kumar and Ahmad, 2015). *Episyrphus balteatus* (De Geer) (Syrphidae : Syrphinae) commonly called as marmalade fly is predominant and distributed throughout the world (Bhatti *et al*., 2022). Adult flies are nectar and pollen feeder (Figs. 1A, B) and larval stages are the most important aphidophagous predators in biological system (Samuel *et al*., 2005).

The sex ratio is a key parameter for the biology of any sexually reproducing organism (Grindot and Pieau, 1993) and in most of the species the sex ratio is 1:1 which is also called as Fisher's principle (Papach *et al*., 2019). The sex

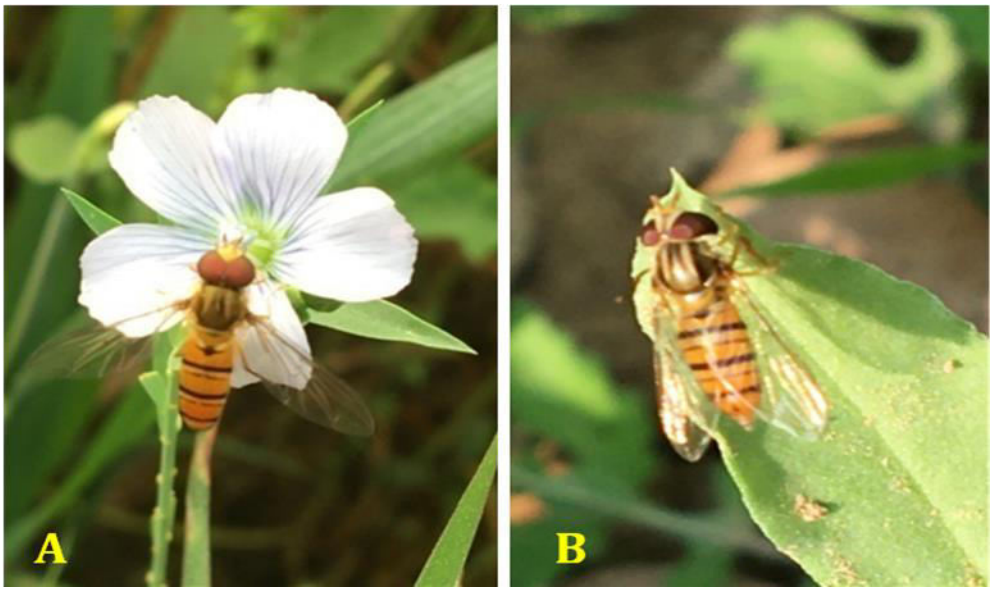

Fig. 1: (A) Male, and (B) Female *Episyrphus balteatus.*

ratio is the proportion of male female progeny in the population. There is variation in sex ratio in randomly mated population and is about 1:1 due to sex chromosomes segregation in gametogenesis (Hoy, 2004). Genetically 1:1 sex ratio is stable that assures the same investment of males and females offspring (Simon, 1994). The variation in the sex ratio influences the rate of reproduction and is effective tool in ecological and evolutionary aspects. To control aphid population, it is very important to study the male-female sex ratio of its predators. *E. balteatus* is economically very important predator as well as good pollinating agent. The study of male-female sex ratio of *E. balteatus* can lead to the best results in biological control progamme in Insect Pest Management.

Materials and Methods

The whole experiment for the study of male female sex ratio was conducted in both the natural environmental condition (in the field) as well as in the laboratory. The collection of adult flies were done during the month of February and March in the different agricultural fields of Bhagalpur district, Bihar. Adult flies were collected with the help of hand net and brought to the laboratory to observe the sex ratio. Majority of adults were collected from the field of *Avena sativa* (oat), *Brassica rapa* (mustard), *Cyamopsis indicus* (guar), *Cajanus cajan* (pigeon pea), *Lablab purpureus* (hyacinth bean), *Triticum aestivum* (wheat) and *Vicia faba* (broad bean).

For the study of the sex ratio of *E. balteatus* under the laboratory condition the collected males and females were brought to the laboratory and kept in beakers for mating and oviposition. After 4-5 days, eggs were hatched into minute transparent larvae. Each larva was kept into different beakers. Every day fresh aphids (*Aphis craccivora*) were provided for their survival. After 6-7 days, they were transformed into pupa and after 8-10 days they turned into adult flies. Males and females were counted to know the sex ratio. The sex ratio of adults was compared to a 1:1 ratio by using χ^2 goodness of fit test.

Results and Discussion

Sex ratio in field collected populations:

The peak population of *E. balteatus* was observed during month of February and March. Hence, the collection was done these months. Total seven samples were taken from the agricultural field of different localities. Total 162 flies were collected out of which 72 were females and 90 were males (72♀: 90♂). The overall sex ratio of the population

Table 1: Sex ratio of *E. balteatus* collected from the field [male-female ratio were compared with the expected 1:1 (F:M) ratio]

Population Sample	No. of adult flies	No. of females	No. of males	Temperature/humidity	F:M
1	11	4	7	19 C/70%	1:0.57
2	20	9	11	18 C/75%	1:1.22
3	34	18	16	23 C/51%	1:0.88
4	20	8	12	27 C/38%	1:1.5
5	27	13	14	31 C/34%	1:1.07
6	30	12	18	36 C/65%	1:1.5
7	20	8	12	34 C/28%	1:1.5
Total	162	72	90		1:1.25

Table 2: Sex ratio of *E. balteatus* in the laboratory condition [male-female ratio were compared with the expected 1:1(F:M) ratio]

Cultured samples	No. of adult flies	No. of females	No. of males	Temperature/ humidity	F:M
1	18	12	6	33 C/36%	1:0.5
2	18	8	10	33 C/45%	1:1.25
3	10	6	4	32 C/34%	1:0.66
4	20	11	9	34 C/45%	1:1.22
Total	66	37	29		1: 0.78

was 1: 1.25 in comparison to the normal sex ratio i.e. 1:1. The difference between the sex ratio in the field population is observed statistically insignificant (χ^2 =2, P<0.05) and in favour of males (Table 1). Thus, the sex ratio in the field population has been observed male biased (excess of male).

Sex ratio in laboratory reared population:

The total number of emerged flies was 66 in which 37 were females and 29 were males (37♀: 29♂). The overall sex ratio in the laboratory cultured population was 1: 0.78 i.e. in favour of females. This difference of the sex ratio is observed insignificant (χ^2 =0.96, P<0.05) (Table 2).

Thus, in the present investigation the number of males is more in the field population as compared to the laboratory condition. This may be due to effects of aphid host/host plant interaction, temperature, humidity etc.

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