Plant Archives Vol. 26, Supplement 2, 2026 pp. 1138-1145 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.supplement-2.133

COMPARATIVE BIONOMICS OF SYRPHID FLY, *Ischiodon scutellaris* FABRICIUS ON DIFFERENT APHID HOSTS

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(Date of Receiving : 27-02-2026; Date of Revision : 09-04-2026; Date of Acceptance : 03-05-2026)

ABSTRACT

The present investigations on the bionomics of syrphid fly, *Ischiodon scutellaris* Fabricius on three aphid hosts *viz.*, cotton aphid, *Aphis gossypii* Glover, knol-khol aphid, *Lipaphis pseudobrassicae* Davis and cabbage aphid, *Brevicoryne brassicae* Linnaeus were carried out under laboratory conditions in the Department of Entomology, B. A. College of Agriculture, Anand Agricultural University, Anand during 2025-26. During the study period, the average duration of egg stage of *I. scutellaris* was 2.67±0.48, 2.87±0.68 and 3.20±0.66 days on *A. gossypii*, *L. pseudobrassicae* and *B. brassicae*, respectively. The mean duration of first, second and third instars was 2.40±0.50, 3.23±0.63 and 3.67±0.61 days, respectively on *A. gossypii*; 2.60±0.50, 3.47±0.50 and 3.93±0.69 days, respectively on *L. pseudobrassicae*; and 2.67±0.48, 3.50±0.57 and 4.30±0.75 days, respectively on *B. brassicae*. The total larval period was 9.30±1.09, 10.00±1.05 and 10.47±1.07 days and average hatching percentage was 76.00, 72.00 and 70.00 percent on *A. gossypii*, *L. pseudobrassicae* and *B. brassicae*, respectively. The mean body length and breadth of female were 8.22±0.09 mm and 2.37±0.10 mm on *A. gossypii*, 8.18±0.09 mm and 2.33±0.08 mm on *L. pseudobrassicae* and 8.11±0.23 mm and 2.31±0.08 mm on *B. brassicae*, respectively. In males, the body length and breadth were 9.00±0.15 mm and 2.53±0.20 mm on *A. gossypii*, 8.58±0.11 mm and 2.51±0.08 mm on *L. pseudobrassicae* and 8.26±0.11 mm and 2.46±0.06 mm on *B. brassicae*, respectively. The fecundity was recorded as 46.50±3.75, 36.50±2.55 and 30.70±2.67 eggs per female, total life span of female was 34.10±2.20, 36.53±1.93 and 38.07±1.86 days, while in male it was 32.10±2.37, 34.73±1.78 and 36.93±1.74 days, the sex ratio was observed as 1:1.27, 1:1.17 and 1:1.08 (male:female), on *A. gossypii*, *L. pseudobrassicae* and *B. brassicae*, respectively.

***Keywords*:** Biology, morphometrics, syrphid fly, cotton aphid, knol-khol aphid, cabbage aphid

Introduction

Aphids (Hemiptera: Aphididae) are among the most destructive insect pests of agricultural crops, causing both direct damage through sap feeding and indirect damage by transmitting plant viruses and promoting the development of sooty mould (Blackman *et al*., 2007). Due to their high reproductive potential and rapid population build-up, aphids often cause severe yield losses under favourable conditions (Rana, 2005).

Indiscriminate use of chemical pesticides for aphid management has led to several adverse effects including destruction of natural enemies and pollinators, development of insecticide resistance, environmental pollution and disruption of ecosystem services (Meena *et al.*, 2013). These challenges necessitate the adoption of ecologically sound and economically viable alternatives, among which biological control using naturally occurring predators is of prime importance. Among which, syrphid flies (Diptera: Syrphidae), commonly known as hoverflies or flower flies, constitute one of the most diverse and ecologically significant groups within the order Diptera. Globally, more than 6,107 species belonging to over 209 genera have been documented (Miranda *et al.*, 2013), while several hundred species have been

recorded from India (Ghorpade, 2014). Among these, members of the subfamily Syrphinae are of particular importance in agricultural ecosystems due to their predatory larval stages, which predominantly feed on aphids and other soft-bodied insects (Mitra *et al.*, 2015). Syrphid flies perform multiple ecological functions, acting as pollinators during the adult stage and as efficient biological control agents during the larval stage (Bhatia, 1939).

The effectiveness of syrphid flies as biological control agents largely depends on their bionomics, including developmental duration, survival, fecundity and adult longevity. Detailed knowledge of these biological parameters is essential for understanding their population dynamics and optimizing their use in pest management programmes (Gilbert, 2005). The duration of different life stages such as egg, larva and pupa, along with reproductive attributes like fecundity, directly influence the rate of population increase and predatory efficiency (Chandler, 1969).

Syrphid larvae are known for their high feeding capacity and play an important role in suppressing aphid populations. However, their development and reproductive performance are greatly influenced by the species of aphid prey. Variations in prey quality can significantly affect larval growth, survival and fecundity (Sadeghi and Gilbert, 2000).

Although several studies have been conducted on the biology of syrphid flies, most investigations are limited to a single aphid host (Chouhan, 2011). Comparative studies on multiple aphid species are essential to identify suitable hosts that support faster development and higher reproductive potential of the predator (Rojo, 2003). Such information is crucial for enhancing their utilization in biological control programmes.

Therefore, the present investigations were undertaken to study the comparative bionomics of the syrphid fly, *Ischiodon scutellaris* Fabricius on different aphid hosts *viz*., cotton aphid, *Aphis gossypii* Glover, knol-khol aphid, *Lipaphis pseudobrassicae* Davis and cabbage aphid, *Brevicoryne brassicae* Linnaeus, under laboratory conditions. The study aims to generate detailed information on developmental duration, adult longevity and fecundity, which will contribute to a better understanding of the species and its potential in biological control programmes.

Materials and Methods

Rearing technique

The study on bionomics of syrphid fly, *I. scutellaris* was carried out under laboratory conditions in the Department of Entomology, Anand Agricultural University (AAU), Anand during 2025-26. The nucleus culture of *I. scutellaris* was established by collecting larvae from cotton (BG II hybrid) at Regional Research Station, AAU, Anand; knol-khol (white vienna) at Entomology Farm, BACA, AAU, Anand and cabbage (local variety) at College Farm, College of Horticulture, AAU, Anand. Collected larvae were maintained individually in Petri plates (9 cm × 1.5 cm). Upon adult emergence, syrphid flies were paired and released into rearing cages (30 × 30 × 30 cm). Cotton wool soaked in 5% honey solution was placed in Petri plates inside each cage to provide food for adults. Aphid-infested plants were introduced into the cages to facilitate natural oviposition.

Host aphid species

The biology of *I. scutellaris* was studied on three different aphid species *viz*., cotton aphid, *A gossypii* maintained on BG II cotton plants, knol-khol aphid, *L. pseudobrassicae* maintained on white vienna knol-khol plants and cabbage aphid, *B. brassicae* maintained on cabbage (local variety) plants.

Egg

Freshly laid eggs (n = 50) were transferred on the aphid-infested leaves in Petri plates using a camel hair brush and examined under a stereoscopic trinocular microscope for morphology, size (length and breadth), incubation period and hatching percentage. The incubation period was recorded by observing the eggs daily until hatching. Egg hatching percentage was calculated as:

$$\text{Egg hatching percentage}(\%) = \frac{\text{Number of larvae emerged out}}{\text{Number of eggs kept}} \times 100$$

Larva (maggot)

Newly hatched larvae were reared individually in Petri plates and supplied with sufficient aphids of respective host species. Observations were recorded on the duration of first, second and third instars. Moulting was confirmed by the presence of exuviae along with changes in larval size and colour. The total larval period was calculated from hatching to pupation. Morphometric measurements, including body length and width of larvae at each instar, were recorded using a stereoscopic trinocular microscope.

Pre-pupal and pupal stage

The pre-pupal period was recorded from the time the larva ceased feeding and became sluggish until formation of the puparium. Pupal period was measured from puparium formation to adult emergence. Observations were recorded on colour, shape, size and

duration. The length and breadth of puparia were measured under a stereoscopic trinocular microscope. Pupation percentage was calculated from the number of puparia formed out of the total larvae observed.

Adult stage

Emerged adults were examined for morphological characteristics, size, colour and sexual dimorphism. Adult longevity was recorded from emergence to death. Fecundity was studied by maintaining 10 pairs of adults in wooden cages provided with aphid-infested plants and 5% honey solution, eggs laid by each female were counted daily. Sex ratio was determined from 50 puparia per treatment maintained until adult emergence; males were distinguished by holoptic (contiguous) compound eyes and females by dichoptic (widely separated) eyes.

Statistical analysis

The data obtained from different observations were statistically analysed and expressed as mean ± standard error (SE).

Results and Discussion

Egg stage

Freshly deposited eggs of *I. scutellaris* were milky white in colour and gradually assumed a pale yellowish-white tint as embryonic development progressed (Plate 1 A). The eggs were elongated and oval to spindle-shaped, tapering gently towards both ends. Under microscopic examination, the chorionic surface exhibited characteristic sculptured patterns consisting of fine, parallel longitudinal ridges that were elevated above the egg surface and intermittently interrupted by shallow depressions containing small longitudinal patches. Similar morphological characteristics were described by Chouhan (2011), Gelot (2014), Beeraganni (2016) and Parmar *et al.* (2025), indicating consistency in egg morphology of this species across different agro-ecological conditions.

The mean egg length and breadth showed slight variation among aphid host treatments. On cotton aphid, eggs measured 0.82 ± 0.01 mm in length and 0.30 ± 0.01 mm in breadth; on knol-khol aphid, 0.81 ± 0.02 mm in length and 0.31 ± 0.01 mm in breadth and on cabbage aphid, 0.79 ± 0.02 mm in length and 0.30 ± 0.01 mm in breadth (Table 2). These measurements are consistent with Chouhan (2011) who reported 0.80-0.90 mm length and 0.28-0.35 mm breadth and Parmar *et al.* (2025) who recorded a mean egg length of 0.83 ± 0.03 mm and width of 0.32 ± 0.01 mm. Oviposition was observed to be solitary, with eggs deposited singly in close proximity to aphid colonies, tallies with observations by Joshi and Ballal (2013).

The mean incubation period of *I. scutellaris* was 2.67 ± 0.48 days on cotton aphid, 2.87 ± 0.68 days on knol-khol aphid and 3.20 ± 0.66 days on cabbage aphid (Table 1). The shortest incubation period on cotton aphid indicates comparatively better suitability of this host for embryonic development. The present findings are in conformity with Chouhan (2011) who reported incubation period as 3.02 ± 0.05 days, Baskaran *et al.* (2009) who recorded 3.10 ± 0.11 days and Parmar *et al.* (2025) who reported 3.04 ± 0.49 days. Mean egg hatching was 76.00% on cotton aphid, 72.00% on knol-khol aphid and 70.00% on cabbage aphid. These values correspond closely to Chouhan (2011) (71.13%), Kulkarni and Patel (2001) (71.11%) and Parmar *et al.* (2025) (72.00%).

Larval stage

The larval stage of *I. scutellaris* comprised three distinct instars representing the active predatory phase. Larvae were soft-bodied, legless, elongated and tapered anteriorly with well-developed mouth hooks and bore spiracular openings posteriorly for respiration.

First instar

The newly hatched larvae were transparent and colourless, which gradually turned creamy white to greenish after the commencement of feeding (Plate 1 B). The body was elongated, tapering anteriorly and broader posteriorly, with indistinct segmentation. The dorsal surface was covered with minute semi-circular tubercular spines, giving a rough appearance.

The morphometric measurements of first instar larvae varied slightly depending on the aphid host. On *A. gossypii*, the body length ranged from 1.54 to 1.75 mm with a mean of 1.63 ± 0.07 mm, while the breadth ranged from 0.45 to 0.51 mm with a mean of 0.48 ± 0.02 mm. On *L. pseudobrassicae*, the length ranged from 1.54 to 1.74 mm (mean 1.62 ± 0.06 mm) and breadth from 0.45 to 0.51 mm (mean 0.48 ± 0.02 mm). Similarly, on *B. brassicae*, the length ranged from 1.50 to 1.72 mm with a mean of 1.59 ± 0.07 mm, while the breadth ranged from 0.43 to 0.51 mm with a mean of 0.47 ± 0.02 mm (Table 2).

The duration of the first instar varied with different aphid hosts and ranged from 2.00 to 3.00 days on all the hosts under study. The mean duration was 2.40 ± 0.50 days on *A. gossypii*, 2.60 ± 0.50 days on *L. pseudobrassicae* and 2.67 ± 0.48 days on *B. brassicae*. Among the three hosts, the duration was shortest on *A. gossypii* and longest on *B. brassicae*, indicating the influence of host aphid species on larval development (Table 1). The present findings are in close agreement with earlier reports, which indicated that the duration

of first instar larvae of syrphid flies ranged between 2 to 3 days depending on host species (Parmar *et al*., 2025). Similar observations were also reported by Sadeghi and Gilbert (2000), who emphasized the importance of prey quality in influencing larval development of aphidophagous hoverflies.

Second instar

The freshly moulted second instar larva was light green to greenish-yellow in colour (Plate 1 C). A faint yellowish longitudinal stripe was observed along the mid-dorsal line, extending throughout the body length. The larva was elongated, legless and maggot-like in form, tapering anteriorly and comparatively broader posteriorly. The integument appeared slightly thicker than that of the first instar and segmentation became more distinct. The dorsal surface exhibited fine transverse folds, giving the body a slightly wrinkled appearance. The larva was more active and exhibited increased feeding intensity during this stage.

The morphometric measurements of second instar larvae showed variation among different aphid hosts. On *A. gossypii*, the body length ranged from 3.10 to 3.42 mm with a mean of 3.25 ± 0.10 mm, while the breadth ranged from 0.92 to 1.05 mm with a mean of 0.98 ± 0.04 mm. On *L. pseudobrassicae*, the length ranged from 3.05 to 3.40 mm (mean 3.21 ± 0.11 mm) and breadth from 0.90 to 1.04 mm (mean 0.97 ± 0.05 mm). Similarly, on *B. brassicae*, the length ranged from 3.00 to 3.35 mm with a mean of 3.18 ± 0.11 mm, while the breadth ranged from 0.88 to 1.02 mm with a mean of 0.95 ± 0.05 mm (Table 2).

The duration of the second instar varied with different aphid hosts. It ranged from 2.00 to 4.00 days on *A. gossypii* with a mean of 3.23 ± 0.63 days, from 3.00 to 4.00 days on *L. pseudobrassicae* with a mean of 3.47 ± 0.50 days and from 2.00 to 4.00 days on *B. brassicae* with a mean of 3.50 ± 0.57 days. Among the three hosts, the duration was shortest on *A. gossypii* and longest on *B. brassicae*, indicating the influence of host aphid species on larval development (Table 1). A comparable duration of second instar larvae ranging between 2 to 4 days has been reported in *I. scutellaris* by Mishra *et al.* (2012), similarly Parmar *et al.* (2025) documented a mean duration of 3.30 ± 0.50 days for the second instar of *I. scutellaris* on mustard aphid, further supporting the consistency of the present observations across different host systems. Furthermore, Gelot *et al.* (2014) reported that the second instar duration of *Xanthogramma scutellare* varied between 3.28 ± 0.45 and 3.66 ± 0.50 days when reared on different aphid hosts.

Third instar

The third instar larvae were the largest and most active among all larval stage under study. The body was elongated, smooth and maggot-like, with clearly visible segmentation. The larvae exhibited a greenish appearance due to continuous feeding activity. The anterior end was narrow and tapering, while the posterior end was broader, giving a characteristic slug-like form (Plate 1 D). This instar showed maximum mobility and feeding activity compared to earlier stages.

The morphometric measurements of third instar larvae showed noticeable variation among different aphid hosts. On *A. gossypii*, the body length ranged from 7.20 to 7.85 mm with a mean of 7.52 ± 0.18 mm, while the breadth ranged from 1.85 to 2.10 mm with a mean of 1.96 ± 0.08 mm. On *L. pseudobrassicae*, the length ranged from 7.05 to 7.70 mm (mean 7.38 ± 0.20 mm) and breadth from 1.80 to 2.05 mm (mean 1.92 ± 0.09 mm). Similarly, on *B. brassicae*, the length ranged from 6.95 to 7.60 mm with a mean of 7.28 ± 0.21 mm, while the breadth ranged from 1.75 to 2.00 mm with a mean of 1.88 ± 0.09 mm (Table 2).

The duration of the third instar varied among different aphid hosts and ranged from 3.00 to 5.00 days. The mean duration was 3.67 ± 0.61 days on *A. gossypii*, 3.93 ± 0.69 days on *L. pseudobrassicae* and 4.30 ± 0.75 days on *B. brassicae*. Among the hosts, the duration was shortest on *A. gossypii* and longest on *B. brassicae*, indicating a clear influence of host species on larval development (Table 1). A similar duration of third instar larvae ranging from 3 to 4 days has been reported by Mishra *et al.* (2012) in *I. scutellaris*, where the third instar lasted between 3 to 4 days. Further support is provided by Parmar *et al.* (2025), who reported a mean duration of 3.68 ± 0.55 days for the third instar of *I. scutellaris* on mustard aphid, which closely aligns with the present results.

Total larval period

The total larval period of *I. scutellaris* varied depending upon the aphid host species under study. The larvae completed development through three instars and the combined duration ranged from 7.00 to 11.00 days on *A. gossypii*, 8.00 to 12.00 days on *L. pseudobrassicae* and 7.00 to 12.00 days on *B. brassicae*. The mean total larval duration was 9.30 ± 1.09 days on *A. gossypii*, 10.00 ± 1.05 days on *L. pseudobrassicae* and 10.47 ± 1.07 days on *B. brassicae* (Table 1). A similar range of total larval duration (7 to 11 days) has been reported by Mishra *et al.* (2012), Gelot *et al.* (2014) also reported that the total larval duration of syrphid larvae varied between

approximately 9 to 11 days depending on the aphid host.

Pre-pupal stage

At the end of the third instar, the fully grown larva entered a short transitional phase known as the pre-pupal stage. During this period, the larva gradually ceased feeding and became less active. The body contracted slightly and appeared shorter and broader than in the actively feeding larval stage. The colour changed from greenish to a duller shade, indicating the onset of pupation. The larva attached itself firmly to the substrate, usually on leaf surfaces or nearby structures, in preparation for pupation. The duration of the pre-pupal stage varied slightly depending on the aphid host species and ranged from 1.00 to 2.00 days. The mean duration was 1.23 ± 0.43 days on *A. gossypii*, 1.33 ± 0.48 days on *L. pseudobrassicae* and 1.43 ± 0.50 days on *B. brassicae* (Table 1).

Pupal stage

The pupal stage of *I. scutellaris* was characterized by a typical coarctate pupa. The pupa was oval to barrel-shaped and remained enclosed within the hardened larval skin (puparium). Initially, the pupa appeared greenish or light brown in colour, which gradually darkened to brown as development progressed (Plate 1 E). The pupa remained immobile and attached to the substrate throughout the developmental period.

The morphometric measurements of the pupa varied slightly depending on the aphid host species. On *A. gossypii*, the pupal length ranged from 5.80 to 6.45 mm with a mean of 6.12 ± 0.18 mm, while the breadth ranged from 2.10 to 2.45 mm with a mean of 2.28 ± 0.10 mm. On *L. pseudobrassicae*, the length ranged from 5.65 to 6.30 mm (mean 6.00 ± 0.20 mm) and the breadth from 2.05 to 2.40 mm (mean 2.22 ± 0.11 mm). Similarly, on *B. brassicae*, the pupal length ranged from 5.50 to 6.20 mm with a mean of 5.88 ± 0.21 mm, while the breadth ranged from 2.00 to 2.35 mm with a mean of 2.18 ± 0.11 mm (Table 2).

The duration of the pupal stage varied among different aphid hosts. It ranged from 7.00 to 9.00 days on *A. gossypii*, 9.00 to 11.00 days on *L. pseudobrassicae* and 9.00 to 12.00 days on *B. brassicae*. The mean pupal duration was 8.20 ± 0.76 days on *A. gossypii*, 9.60 ± 0.56 days on *L. pseudobrassicae* and 10.30 ± 0.84 days on *B. brassicae*. The pupation percentage was recorded as 96.00 per cent on *A. gossypii*, 92.00 per cent on *L. pseudobrassicae* and 90.00 per cent on *B. brassicae* (Table 1).

A comparable pupal duration ranging from 9 to 11 days has been reported by Mishra *et al.* (2012) in *I. scutellaris.* Similarly, Gelot *et al.* (2014) also reported that the pupal duration of syrphid flies varied between 9 to 11 days depending on the aphid host, indicating the influence of prey quality on pupal development. Further support is provided by Kulkarni and Patel (2001), who reported a pupal duration of 9 to 11 days in syrphid flies under laboratory conditions and also reported pupal length ranging from 5.13 to 7.50 mm and breadth from 2.13 to 3.13 mm. Parmar *et al.* (2025) also recorded comparable pupal duration in *I. scutellaris*, reinforcing the consistency of the present observations.

Adult stage

The adults of *I. scutellaris* were slender, active flies exhibiting characteristic hovering behaviour. The body was elongated and distinctly divided into head, thorax and abdomen. The adults were highly active and commonly observed near aphid-infested plants, where females laid eggs singly in close proximity to aphid colonies. The adults exhibited slight sexual dimorphism, with males being marginally larger than females in terms of body size and arranegement of eyes, in males the eyes were holoptic *i.e.* both eyes are contiguous at the top of the head, whereas in females the eyes were separated by a wide frons (dichoptic condition) (Plate 1 F-J).

The morphometric measurements of adult flies varied among different aphid hosts. On *A. gossypii*, the body length of females ranged from 7.80 to 8.60 mm with a mean of 8.20 ± 0.22 mm, whereas males ranged from 7.90 to 8.70 mm with a mean of 8.28 ± 0.20 mm. The body breadth of females ranged from 2.40 to 2.70 mm (mean 2.55 ± 0.09 mm) and that of males from 2.45 to 2.75 mm (mean 2.60 ± 0.08 mm). On *L. pseudobrassicae*, the body length of females ranged from 7.70 to 8.50 mm with a mean of 8.12 ± 0.24 mm, while males ranged from 7.85 to 8.60 mm with a mean of 8.20 ± 0.22 mm. The breadth of females ranged from 2.35 to 2.65 mm (mean 2.50 ± 0.10 mm), whereas males ranged from 2.40 to 2.70 mm (mean 2.55 ± 0.09 mm). Similarly, on *B. brassicae*, the body length of females ranged from 7.60 to 8.40 mm with a mean of 8.05 ± 0.25 mm, while males ranged from 7.75 to 8.50 mm with a mean of 8.15 ± 0.23 mm. The breadth of females ranged from 2.30 to 2.60 mm (mean 2.45 ± 0.11 mm), whereas males ranged from 2.35 to 2.65 mm (mean 2.50 ± 0.10 mm) (Table 2). Similarly, Kulkarni and Patel (2001) reported that the body length of syrphid adults ranged from approximately 7.00 to 9.88 mm, which closely corresponds with the present measurements. Similarly, Chouhan (2011) recorded an

average body length of around 8 mm in *I. scutellaris*, further supporting the present observations.

Adult longevity

The longevity of adults differed between sexes and varied with aphid host species. On *A. gossypii*, the longevity of females ranged from 14.00 to 17.00 days with a mean of 15.37 ± 0.72 days, while males lived for 12.00 to 15.00 days with a mean of 13.37 ± 0.89 days. On *L. pseudobrassicae*, the female longevity ranged from 14.00 to 17.00 days (mean 15.60 ± 0.97 days) and male longevity from 13.00 to 15.00 days (mean 13.80 ± 0.66 days). On *B. brassicae*, females lived for 14.00 to 17.00 days (mean 15.87 ± 1.25 days) and males for 13.00 to 16.00 days (mean 14.73 ± 0.98 days) (Table 1). The observed adult longevity, ranging from 12 to 17 days, is in close agreement with earlier reports under laboratory conditions. Mishra *et al.* (2012) reported that the longevity of male adults ranged between 12 to 18 days, while females survived for a relatively longer period. Similarly, Kulkarni and Patel (2001) documented adult longevity ranging from 13 to 17 days in syrphid flies, which supports the present findings.

Total life span

The total life span (egg to adult death) also varied among hosts. The female life span ranged from 29.00 to 39.00 days (mean 34.10 ± 2.20 days) on *A. gossypii*, 32.00 to 41.00 days (mean 36.53 ± 1.93 days) on *L. pseudobrassicae* and 33.00 to 42.00 days (mean 38.07 ± 1.86 days) on *B. brassicae*. Similarly, male life span ranged from 27.00 to 37.00 days (mean 32.10 ± 2.37 days) on *A. gossypii*, 31.00 to 39.00 days (mean 34.73 ± 1.78 days) on *L. pseudobrassicae* and 32.00 to 41.00 days (mean 36.93 ± 1.74 days) on *B. brassicae*.

Fecundity

The fecundity of female flies varied with aphid host species. The number of eggs laid per female ranged from 42 to 53 (mean 46.50 ± 3.75) on *A. gossypii*, 33 to 41 (mean 36.50 ± 2.55) on *L. pseudobrassicae* and 27 to 35 (mean 30.70 ± 2.67) on *B. brassicae*. Chouhan (2011) reported a fecundity of approximately 25 eggs per female in *I. scutellaris*, whereas Parmar *et al.* (2025) documented a mean fecundity of around 34.45±2.40 eggs per female, which falls within the range observed in the present investigation. Palial (2023) documented a fecundity of 34.22 eggs per female in *I. scutellaris* when reared on *B. brassicae*, which is consistent with the results obtained in the present investigation.

Sex ratio

The sex ratio (male:female) of *I. scutellaris* varied slightly with the aphid host and was recorded as 1:1.27 on *A. gossypii*, 1:1.17 on *L. pseudobrassicae* and 1:1.08 on *B. brassicae*, indicating a female-biased population under all host conditions (Table 1). Chouhan (2011) reported a male to female ratio of 1:1.27 in *I. scutellaris* under laboratory conditions, which supports the present findings. Similarly, Parmar (2025) observed that the sex ratio of laboratory-reared adults of *I. scutellaris* was approximately 1:1.25.

Conclusion

In nutshell, the bionomics of *I. scutellaris* were significantly influenced by the aphid host species. The total developmental period was shortest on *A. gossypii* (18.73 ± 1.48 days) followed by *L. pseudobrassicae* (20.93 ± 1.78 days) and longest on *B. brassicae* (22.20 ± 1.42 days). The shortest life span was recorded on *A. gossypii* (34.10 ± 2.20 days for females; 32.10 ± 2.37 days for males), followed by *L. pseudobrassicae* (36.53 ± 1.93 days for females; 34.73 ± 1.78 days for males), while the longest was observed on *B. brassicae* (38.07 ± 1.86 days for females; 36.93 ± 1.74 days for males). Similarly, the highest fecundity was recorded on *A. gossypii* (46.50 ± 3.75 eggs/female), followed by *L. pseudobrassicae* (36.50 ± 2.55 eggs/female) and *B. brassicae* (30.70 ± 2.67 eggs/female). The sex ratio was female-biased on all hosts.

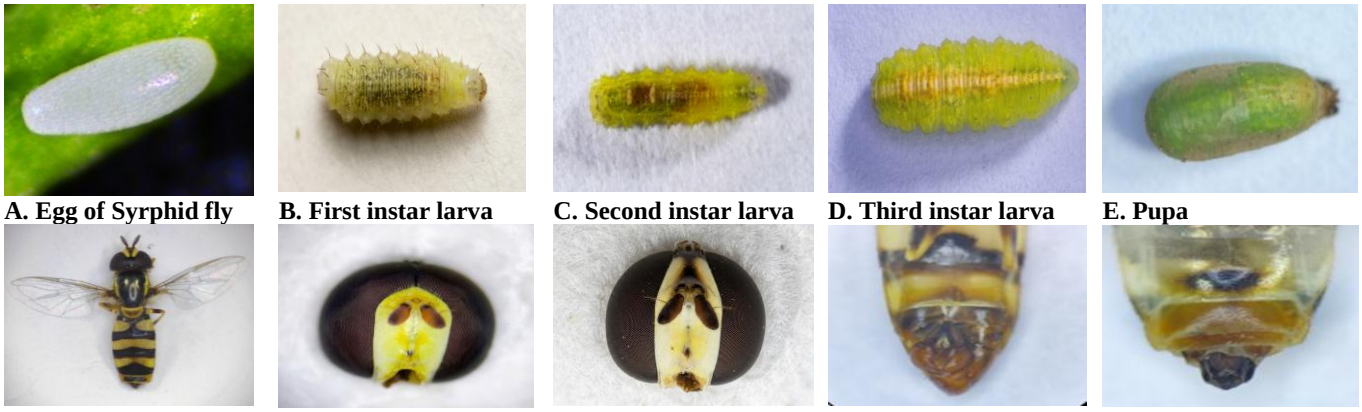
Table 1: Duration of different life stages of *I. scutellaris* on cotton aphid, *A. gossypii*, knol-khol aphid, *L. pseudobrassicae* and cabbage aphid, *B. brassicae*

Life stages of *I. scutellaris*	Cotton aphid, *A. gossypii*			Knol-khol aphid, *L. pseudobrassicae*			Cabbage aphid, *B. brassicae*		
	Duration in day(s)			Duration in day(s)			Duration in day(s)		
	Min.	Max.	Mean ± SD	Min.	Max.	Mean ± SD	Min.	Max.	Mean ± SD
Egg									
Incubation period	2.00	3.00	2.67 ± 0.48	2.00	4.00	2.87 ± 0.68	2.00	4.00	3.20 ± 0.66
Hatching (%)	76.00			72.00			70.00		
Larva (maggot)									
I instar	2.00	3.00	2.40 ± 0.50	2.00	3.00	2.60 ± 0.50	2.00	3.00	2.67 ± 0.48
II instar	2.00	4.00	3.23 ± 0.63	3.00	4.00	3.47 ± 0.50	2.00	4.00	3.50 ± 0.57
III instar	3.00	5.00	3.67 ± 0.61	3.00	5.00	3.93 ± 0.69	3.00	5.00	4.30 ± 0.75

Total larval period	7.00	11.00	9.30 ± 1.09	8.00	12.00	10.00 ± 1.05	7.00	12.00	10.47 ± 1.07
Pupa									
Pre-pupal period	1.00	2.00	1.23 ± 0.43	1.00	2.00	1.33 ± 0.48	1.00	2.00	1.43 ± 0.50
Pupal period	7.00	9.00	8.20 ± 0.76	9.00	11.00	9.60 ± 0.56	9.00	12.00	10.30 ± 0.84
Pupation (%)	96.00			92.00			90.00		
Total developmental period	15.00	22.00	18.73±1.48	18	24	20.93 ± 1.78	19	25	22.20 ± 1.42
Adult Longevity									
Female	14.00	17.00	15.37 ± 0.72	14.00	17.00	15.60 ± 0.97	14.00	17.00	15.87 ± 1.25
Male	12.00	15.00	13.37 ± 0.89	13.00	15.00	13.80 ± 0.66	13.00	16.00	14.73 ± 0.98
Total life span									
Female	29.00	39.00	34.10 ± 2.20	32.00	41.00	36.53 ± 1.93	33.00	42.00	38.07 ± 1.86
Male	27.00	37.00	32.10 ± 2.37	31.00	39.00	34.73 ± 1.78	32.00	41.00	36.93 ± 1.74
Fecundity (No. of eggs laid/female)	42	53	46.5 ± 3.75	33	41	36.50 ± 2.55	27	35	30.7 ± 2.67
Sex ratio (Male : Female)	1:1.27			1:1.17			1:1.08		

Table 2: Morphometrics of different life stages of *I. scutellaris* on cotton aphid, *A. gossypii*, knol-khol aphid, *L. pseudobrassicae* and cabbage aphid, *B. brassicae*

Lie stages of *I. scutellaris*	Measurements	Cotton aphid, *A. gossypii*			Knol-khol aphid, *L. pseudobrassicae*			Cabbage aphid, *B. brassicae*		
		Min.	Max.	Mean ± SD	Min.	Max.	Mean ± SD	Min.	Max.	Mean ± SD
Egg	Length (mm)	0.80	0.84	0.82 ± 0.01	0.77	0.85	0.81 ± 0.02	0.75	0.82	0.79 ± 0.02
	Breadth (mm)	0.29	0.33	0.30 ± 0.01	0.29	0.33	0.31 ± 0.01	0.28	0.32	0.30 ± 0.01
1st instar larva	Length (mm)	1.54	1.75	1.63 ± 0.07	1.54	1.74	1.62 ± 0.06	1.50	1.72	1.59 ± 0.07
	Breadth (mm)	0.45	0.51	0.48 ± 0.02	0.45	0.51	0.48 ± 0.02	0.43	0.51	0.47 ± 0.02
2nd instar larva	Length (mm)	4.87	4.99	4.93 ± 0.04	4.86	4.99	4.92 ± 0.04	4.82	4.98	4.90 ± 0.05
	Breadth (mm)	0.79	0.86	0.82 ± 0.02	0.77	0.85	0.82 ± 0.03	0.75	0.85	0.80 ± 0.03
3rd instar larva	Length (mm)	12.35	12.72	12.54 ± 0.11	12.32	12.68	12.50 ± 0.12	12.25	12.65	12.45 ± 0.13
	Breadth (mm)	2.10	2.23	2.16 ± 0.04	2.09	2.20	2.15 ± 0.04	2.05	2.19	2.13 ± 0.04
Pupa	Length (mm)	5.87	6.03	5.95 ± 0.05	5.85	6.02	5.94 ± 0.06	5.80	6.02	5.92 ± 0.07
	Breadth (mm)	2.18	2.27	2.23 ± 0.03	2.17	2.26	2.22 ± 0.03	2.14	2.26	2.20 ± 0.04
Male adult	Length (mm)	8.78	9.25	9.00 ± 0.15	8.44	8.81	8.58 ± 0.11	8.05	8.44	8.26 ± 0.11
	Breadth (mm)	1.82	2.64	2.53 ± 0.20	2.25	2.60	2.51 ± 0.08	2.32	2.56	2.46 ± 0.06
Female adult	Length (mm)	8.09	8.38	8.22 ± 0.09	8.02	8.31	8.18 ± 0.09	7.45	8.36	8.11 ± 0.23
	Breadth (mm)	2.09	2.49	2.37 ± 0.10	2.07	2.40	2.33 ± 0.08	2.07	2.41	2.31 ± 0.08



A. Egg of Syrphid fly | **B. First instar larva** | **C. Second instar larva** | **D. Third instar larva** | **E. Pupa**

F. Adult | **G. Adult of male syrphid fly possesses holoptic eyes** | **H. Adult of female syrphid fly possesses dichoptic eyes** | **I. Male Syrphid fly** | **J. Female Syrphid fly**

Plate 1: Different life stages of syrphid fly, *I. scutellaris*

References

Baskaran, R. M., Sasikumar, S., Rajavel, D. S., & Suresh, K. (2009). Biology and predatory potential of aphidophagous syrphids on guava aphid, *Aphis gossypii* Glover (Hemiptera: Aphididae). *Journal of Biological Control*, **23** (1), 53-56.

Beeraganni, K. (2016). *Survey and morphometrical studies of syrphids (Syrphidae: Diptera)* (Doctoral thesis, Navsari Agricultural University, Navsari).

Bhatia, M. L. (1939). Biology, morphology and anatomy of aphidophagous syrphid larvae. *Parasitology*, **31** (1), 78-120.

Blackman, R. L., Eastop, V. F., Van Emden, H. F., & Harrington, R. (2007). Aphids as crop pests. *Taxonomic Issues*,**1**, 1-29.

Chandler, A. E. F. (1969). Locomotory behaviour of first instar larvae of aphidophagous Syrphidae (Diptera) after contact with aphids. *Animal Behaviour*, **17** (4), 673-678.

Chouhan, K. S. (2011). *Bionomics, feeding potential and evaluation of insecticides for their safety to syrphid fly, Ischiodon scutellaris* (Fabricius) (Master's thesis, Anand Agricultural University, Anand).

Gelot, P. P. (2014). *Comparative biology of syrphid fly, Xanthogramma scutellare (Fab.) on different aphid species* (Master's thesis, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar).

Ghorpade, K. (2014). An updated checklist of the hoverflies (Diptera: Syrphidae) recorded in the Indian subcontinent. *Colemania*, **44**, 1-30.

Gilbert, F. (2005). The evolution of imperfect mimicry. In *Symposium-Royal Entomological Society of London*, **22**, 231.

Joshi, S., & Ballal, C. R. (2013). Syrphid predators for biological control of aphids. *Journal of Biological Control*, **27** (3), 151-170.

Kulkarni, A. V., & Patel, I. S. (2001). Bionomics of *Xanthogramma scutellare*, an effective predator of mustard aphid. *Indian Journal of Entomology*, **63** (3), 267-271.

Meena, H., Singh, S. P., & Nagar, R. (2013). Evaluation of microbial agents and bio-products for the management of mustard aphid, *Lipaphis erysimi* (Kalt). *The Bioscan*, **8** (3), 747-750.

Miranda, G. F., Young, A. D., Locke, M. M., Marshall, S. A., Skevington, J. H., & Thompson, F. C. (2013). Key to the genera of Nearctic Syrphidae. *Canadian Journal of Arthropod Identification*, **23**, (1), 351.

Mishra, I., Mandal, S. M., & Mishra, B. K. (2012). Biology and predatory potentiality of *Ischiodon scutellaris* (Fab) on *Aphis craccivora* (Koch). *Journal of Plant Protection and Environment*, 9 (2), 42-45.

Mitra, B., Roy, S., Imam, I., & Ghosh, M. (2015). A review of hover flies (Syrphidae: Diptera) from India. *International Journal of Fauna and Biological Studies*, **2** (3), 61-73.

Palial, S. (2023). *Studies on diversity, population dynamics and predatory potential of syrphids against Brevicoryne brassicae (L.) infesting cruciferous crops in Himachal Pradesh*. (Doctoral thesis, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Solan (Nauni), Himachal Pradesh).

Parmar, N. L. (2025). *Biology and seasonal incidence of syrphid fly in mustard*. (Master's Thesis, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar).

Parmar, N. L., Deb, S., Joshi, V. J., & Chandaragi, M. K. (2025). Laboratory study on biology of syrphid fly, *Ischiodon scutellaris* (Fabricius) on mustard aphid. *International Journal of Agriculture Extension and Social Development*, **8** (12), 152-156.

Rana, J. S. (2005). Performance of *Lipaphis erysimi* on different brassica species in a tropical environment. *Journal of Pest Science*, **78**, 155-160.

Rojo, S. (2003). *A world review of predatory hoverflies (Diptera, Syrphidae: Syrphinae) and their prey*. Murcia, Spain: Ibero-American Center for Biodiversity, University of Alicante.

Sadeghi, H., & Gilbert, F. (2000). Oviposition preferences of aphidophagous hoverflies. *Ecological Entomology*, **25**(1), 91-100.