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# Life cycle and biology of apple blossom Thrips (*Thrips carthami*) in Kashmir Valley

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**Abstract**
Thrips of Kashmir region on apple crop have been poorly studied despite their significance as far as the importance of crop in our valley is concerned. So, in this regard a research trial was carried out on Life Cycle and Biology of Blossom Thrips on Apple in Kashmir during 2016 and 2017. The studies on biology revealed that the life cycle of the pest have several developmental stages: egg, first and second larva instar, prepupa, pupa and adult. All the stages of the pest except pre pupa and pupa were sampled from apple tree and were taken to laboratory for examination. For pre pupa and pupa, samples consisted of four 320 $cm^2$ subsamples, with three samples per orchard. The four subsamples consisted of the top 2 cm of the soil lying near the canopy of the plant. All the four subsamples were collected within a 2 m radius and placed together in labeled plastic bags. Thrips were extracted into a 70% ethanol and 1% formaldehyde solution in Berlese funnels (60-W bulb) for 3 days and subsequently enumerated and identified. Egg hatches in 1- 2 days' time, nympal and pupal period lasts for 8- 9 days and 3-4 days respectively. The adults survive for 6-8 days. The thrip thus completes its life cycle in 15-17 days on apple. The thrip survives for three successive generations on apple from mid-march up to ending April. After completing all the three generations on apple, the thrip then moves over to alternate hosts like *Matricaria chamomilla*, *Ranunculus acris*, and *Ageratum conyzoides* and feed on these flowering weeds till the onset of November and go far hibernation in crevices, under the weeds debris and in the soil. The thrip comes up again from the hibernation process in the form of adult and resumes its life cycle again.

**Keywords:** Thrips, larva, Prepupa, pupa, ethanol, Berlese funnels

## Introduction
The genus *Thrips* Linnaeus is the largest in the subfamily Thripinae, with 293 described species in the world (Thrips Wiki, 2018) [19]. About 7400 species of thrips has been reported worldwide (Mound, 2012) [14], out of which five hundred species of thrips are known to infest different vegetables (Mound and Kou, 1996) [13]. Thrips (Thysanoptera: Thripidae) are economic pests of deciduous fruit tree crops, causing direct damage during fruit development or as fruits mature. Worldwide, at least12 thrips species have been reported to cause economic damage to deciduous fruits (Broughton *et al.*, 2011) [2]. They cause economic damage in different crops by feeding and virus transmission (Lewis, 1973).Yield losses in certain vegetable crops like cucumber, cardamom, onion, garlic and tomato due to thrips were estimated up to 50-100 per cent in various regions (Cooper, 1990; Kumar *et al.*, 2001; Dharmadasa *et al.*, 2008, Diaz *et al*., 2011 and Kunkalikar, 2011) [5, 8, 6, 7, 9]. Damage during fruit development is caused when females oviposit eggs in flower buds and flowers (Pearsall and Myers 2000) [16]. In apples, cherries, pears, and plums, oviposition damage may cause 'pansy spots'. This damage results from scar tissue (<1 mm) forming over the oviposition site, and is often surrounded by a pansy-shaped white discolouration (Cockfield *et al*., 2007; Terry, 1991) [4, 18]. In plums, apples and cherries, dimples also form as a result of the differential growth between injured and uninjured tissue around the oviposition site (Allsopp, 2010) [1]. Damage to maturing fruits (late season) occurs as fruits ripen, usually after the fruit has coloured. Nectarines are particularly susceptible to silvering. Thrips may be attracted to nectarines due to changes in the odour of the ripening fruit (LaRue *et al*., 1972) [10] or a combination of olfactory, gustatory and tactile cues (Teulon *et al*., 1993) [17]. All types of thrips damage can cause fruit to be culled or downgraded. They increase their population gradually in early season (Meena *et al*., 2013) [12] and multiply rapidly, because of which they are not feasible to control easily. The timing of thrips oviposition on apple fruit is still a matter of dispute. Newcomer (1921) was first to discover thrips eggs in the center of pansy spots.

He deduced that oviposition must occur "sometime during bloom", and advocated an insecticide application at pink (opening flower buds) to control the adults responsible. Venables (1925) [20] believed that oviposition in fruit occurred "sometime between bloom and closing of the calyx", which occurs shortly after at 80 per cent petal fall. Childs (1927) [3] observed oviposition in fruit occurring much later, shortly after bloom and continues until fruits were about 25-38 mm diameter.

Thrips in apple ecosystem in Kashsmir are devastating particularly during flowering. The infestation is very high particularly in district Bandipora. The period of flowering coupled with inclement weather makes it very difficult to control the pest. Not much is known about its biology and therefore management of this pest has become a challenge. For this reason a research trial were conducted for the year 2016 and 2017 in Kashmir valley to determine the life cycle of blossom thrips on apple so that nature of the pest could be easily understood for future strategies.

## Materials and Methods

Densities of eggs, larvae and adult thrips on apple were assessed in 2016-2017 by using method described by (Lewis, 1997). Three plots consisting of five trees each (4 at corners and one at the middle) were selected. Densities were recorded by sampling 5 flower clusters (each with five to six flowers) from four directions and one at center which resulted 25 flower clusters per tree from four directions and at center for 125 flower clusters per treatment per sampling date at Tight Cluster, Pink Bud and Petal fall stages of apple. Samples were placed in self-sealing plastic bags, stored at 5 °C and processed within a week. Thrips were separated from plant tissues by filling the bag with water, adding a few drops of liquid detergent, and agitating for several seconds. Thrips and plant material were separated from the soapy water by pouring through two nested sieves (Hubbard Scientific Co., Northbrook, IL). The larger sieve (#10, 0.25 mm mesh) trapped most of the plant material, and the finer sieve (#230, 0.0014 mm mesh) trapped the thrips. Thrips were then rinsed into a vial of 50% ethanol. Adults and larvae were recorded separately. After the plant tissue samples were washed, blossom clusters were trimmed so that only the ovary tissues remained, and these were examined for thrips eggs. A staining technique (Backus *et al.* 1988) (Teulon and Cameron 1995) was used. Trimmed plant tissues were placed in McBride's stain (0.2% acid fuchsin in 95% ethanol and glacial acetic acid (1:1 vol/vol) for 24 h, then transferred to clearing solution consisting of one part each of distilled water, 99% glycerin, and 85% lactic acid (1:1:1 vol/vol/vol). Samples in the clearing solution were heated in a double boiler under a fume hood for 1 h to soften the tissue. After clearing, samples of plant tissue were sliced off to a thickness of 0.5 mm, and the remaining hard portion of tissue was discarded. The thin tissue was observed under a dissecting microscope using Tran's illumination to reveal the eggs. All the stages of the pest except pre pupa and pupa were sampled from apple tree. For pre pupa and pupa, samples consisted of four 320 $cm^2$ subsamples, with three samples per orchard. The four subsamples consisted of the top 2 cm of the soil lying near the canopy of the plant. All the four subsamples were collected within a 2 m radius and placed together in labeled plastic bags. Thrips were extracted into a 70% ethanol and 1% formaldehyde solution in Berlese funnels (60-W bulb) for 3 days and subsequently enumerated and identified.

## Results and Discussion

The general life cycle of *Thrips carthami* is similar to that of other species in the family Thripidae, consisting of an egg, two active feeding larval instars, two relatively quiescent pupal instars and the adult. Adults and larvae aggregate in flowers or other concealed areas on plants, such as developing foliage and flower buds. Females have a saw like ovipositor, which they use to deposit eggs into leaves, petioles, flower bracts and petals. In the present study all the life stages were found on apple blossom during bloom, expect the prepupa and pupa which dropped to the ground to pupate. Eggs were kidney shaped which hatched in 1- 2 day's time, ist instar larvae molted to second instar larvae in 2 to 3 days which was much bigger and had more colour and second instar molted into pre-pupa in 5 to 6 days and pre pupa into pupa in 3 to 4 days. The prepupal and pupal instars were recognized by their developing wing buds. The adults survived for 2-3 days in case of males and 3-4 days in case of females and had fully developed pair of fringed wings. The thrip thus completed its life cycle in 13-18 days (males) and 14-19 days (females) on apple. The thrip survived for three successive generations on apple from Mid-March upto ending April. After completing all the three generations on apple, the thrip then moved over to alternate hosts like *Matricaria Chamomilla* (Chamomile), *Ranunculus acris* (Buttercup) and *Ageratum conyzoides* (Chickweed) and fed on these flowering weeds till the onset of November and went for hibernation in crevices, under the weeds debris and in the soil. The thrip emerged again from the hibernation process in the form of adult and resumed its life cycle again.

**Table 1:** Field biology of *Thrips Carthami* on apple in Kashmir for the years 2016 and 2017

| Stage | Duration (in days) | | Mean ± SE |
|---|---|---|---|
| | Minimum | Maximum | |
| Egg | 01 | 02 | 1.5 ± 0.20 |
| Ist instar larvae | 02 | 03 | 2.5 ± 0.26 |
| 2nd instar larvae | 05 | 06 | 5.5 ± 0.32 |
| Pupa | 03 | 04 | 3.5 ± 0.37 |
| Adult ♂ | 02 | 03 | 2.50 ± 0.26 |
| Adult ♀ | 03 | 04 | 3.50 ± 0.37 |
| Ist Generation | 15 | 19 | 17± 1.50 |
| 2nd Generation | 14 | 18 | 16± 1.00 |
| 3rdGenaration | 15 | 16 | 15.5± 0.50 |

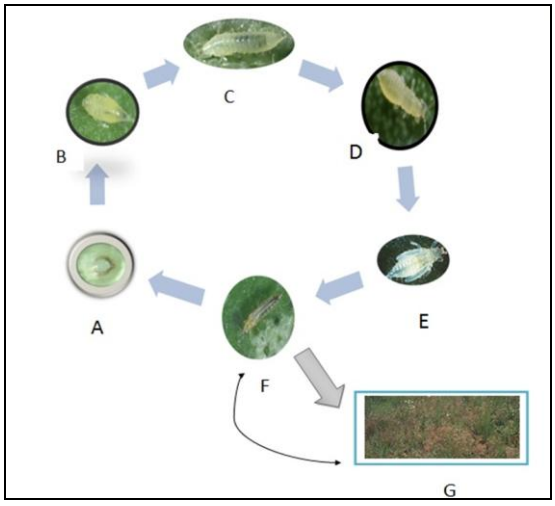


**Fig 1:** Life cycle of *Thrips carthami* A. Egg; B. Ist larvae; C. 2nd larvae; D. Pre-pupa; E. Pupa; F. Adult; G. Weeds (*Ranunculus acris*, *Ageratum conyzoides*, *Matricaria Chamomilla*)

## Conclusion

The studies on biology revealed that the life cycle of the pest consists of several developmental stages *viz*. egg, first and second larva instar, prepupa, pupa and adult. All the life stages were found on apple blossoms during bloom, except the prepupal and pupal stage which were seen on the ground. Egg hatches in 1- 2 days, larval and pupal period lasts for 7- 9 days and 3-4 days respectively and the adults survive for 2-4 days. The thrip thus completes its life cycle in 14-19 days on apple. The thrip survives for three successive generations on apple from mid-March up to ending April. After completing all the three generations on apple, the thrip then moves over to alternate hosts like *Ranunculus acris* (Buttercup). *Matricaria Chamomilla* (Chamomile) and *Ageratum Conyzoides* (Chickweed)and feed on these flowering weeds till the onset of November and go for hibernation in crevices, under the weed debris and in the soil as adults. The hibernating adults resume their activity with the onset of spring.

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