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Species Composition of Thrips Infesting Chilli Crop

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Abstract: Field experiments were conducted during 2014-15, *Kharif* to study the species composition of chilli thrips. The results revealed that species composition of chilli thrips was studied by collecting the thrips from leaves, flowers and fruits and identified by using the taxonomic keys. The thrips species inhabiting the leaves and fruits were identified as *Scirtothrips dorsalis*, while the flowers were colonized by four species of thrips, of which three species viz., *Frankliniella schultzei*, *Thrips palmi* and Thrips hawaiiensis belong to the family Thripidae of Terebrantia sub order and the fourth species *Haplothrips verbasci* belongs to the Tubulifera sub order of phlaeothripidae family. Among blossom thrips, *F. schultzei* was the predominant species constituting 84.4% of the total population followed by *H. verbasci* (10.80%) and *T. hawaiiensis* (4.20%). *T. palmi* was found in very low numbers (4) and it constituted 0.60% of the total population.

Keywords: Species Composition, *Scirtothrips Dorsalis*, *Frankliniella Schultzei*, *Thrips Palmi*, *Thrips Hawaiiensis* and *Haplothrips Verbasci*

1. Introduction

Chilli (*Capsicum annum* L) is an important vegetable and condiment crop grown throughout the world and it has immense commercial, dietary and therapeutic values. India is the world leader in chilli production followed by China & Pakistan. The major chilli exporting countries with their percentage share in world exports are India (25%), China (24%), Spain (17%), Mexico (8%), Pakistan (7.2%), Morocco (7%) and Turkey (4.5%). The bulk share of chilli production in the world is held by Asian countries. In India it is cultivated throughout the country in about 775 thousand hectares with an annual productivity of 1492 thousand Mt. In combined Andhra Pradesh it is grown in an area of 131.32 thousand hectares with an annual production 601.99 thousand Mt. [1].

Although the crop has got great export potential besides huge domestic requirement, a number of limiting factors contribute for its low productivity. Among the various biotic stresses, ravages caused by insect pests are significant. The pest spectrum in chilli is complex with more than 293 insects and mite species debilitating the crop in the field as well as in storage [2]. There were reportedly over 20 insect species in chillies from India of which thrips (*Scirtothrips dorsalis*), mites (*Polyphagotarsonemus latus*) and aphids (*Aphis gosypii* and *A. craccivora*) are among the most damaging pests. Among the sucking pests, chilli thrips *S. dorsalis* Hood (Thripidae: Thysanoptera) is considered as the most serious and important pest as it attacks the crop from nursery till the harvest of the crop [3]. Both nymphs and adults of thrips cause damage by scrapping the epidermis and suck the cell sap from tender leaves, growing shoots and exhibit characteristic upward curling of leaves and reduction in leaf size [4]. Besides damage, thrips also cause indirect damage by transmitting Tospo viruses [5]. The estimated losses due to thrips in chilli ranged from 50 to 90 per cent [6]. Chilli thrips multiply appreciably at a faster rate during dry weather periods and causes yield loss of 30 to 50 per cent in South India [7] and sometimes may cause more than 90 per cent yield reduction [8]. The economic yield loss due to chilli thrips may go up to 11 to 32% (quantitate) and 88% (qualitative) in chilli [9].

In the world at least 16 thrips species have been reported

to cause damage to capsicum [10, 11]. *Frankliniella occidentalis* is the most common thrips species on capsicum in Europe [12], while *Thrips parvispinus* is the main species in Indonesia, Malaysia, Philippines, Thailand and Taiwan [13]. The collected thrips samples from chilli leaves and flowers and showed five species viz., *F. occidentalis*, *T. tabaci*, *S. dorsalis*, *Caliothrips ericae* and *Megalurothrips sjostedti*and among them, the most common thrips species was *F. occidentals* [14]. There were 7 species of thrips in chilli plantation in the region of Jambi and they were *T. parvispinus, T. palmi, T. coloratus, Ceratothripoides brunneus, T. setosus* and *T. hawaiiensis* one unknown species from the suborder Tubulifera [15]. In India *S. dorsalis* was reported as the only species causing damage to chilli leaves. Information pertaining to the species composition of thrips infesting the flowers and fruits is scanty. Practically no work has been done to establish the diversity of thrips species present in different plant parts of chilli crop. It is very important to know the species composition of thrips and its peak activity to take up timely control measures and to establish their role in transmission of several plant viral diseases.

2. Materials and Methods

The experiment was carried out under open field conditions at National Bureau of Plant Genetic Resources (NBPGR), Rajendranagar, Hyderabad during *Kharif*, 2014. The popularly grown chilli variety LCA-334 was used for the study. The experiment was laid out in 10 m × 20 m plot. The plot was divided into 5 quadrates with a gap of 1m between each quadrate. Seeds of chilli variety LCA 334 were sown in the pots and one month old healthy seedlings were transplanted in the main field with a row to row and plant to plant distance of 60 cm x 60 cm. All the recommended agronomic practices like fertilizer application, weeding, hoeing, irrigation etc., were taken up at regular intervals. The crop was raised under unprotected conditions.

2.1. Recording the Pest Data

Observations on thrips species inhabiting the leaves, flowers and fruits were recorded at weekly intervals in the chilli crop after noticing the thrips incidence and continued till the harvest of the crop. For recording the pest incidence, 10 healthy plants were selected randomly from each quadrate and tagged.

2.1.1. Collection of Thrips Species from Chilli Leaves

It is very difficult to take the population counts of the thrips species in the field as they are very minute, very active and inhabit the young terminal leaves. Hence for taking the thrips counts and identifying different species inhabiting the leaves, young terminals were collected from ten plants of each quadrate as described by Amin *et al.* (1981). The thrips species inhabiting the terminal leaves were collected in 250 ml plastic containers containing 70% ethyl alcohol filled to half of its capacity. Thus 10 samples from each quadrate were collected at weekly intervals. After collecting the samples, the labels containing the information about the date of observation and the quadrate from which the samples were collected were written and pasted on the container.

2.1.2. Collection of Thrips Species from Flowers

The thrips species present in the flowers were recorded at weekly intervals starting from the date of flowering till the end of season. The thrips species inhabiting the flowers were recorded by collecting 10 flowers from each quadrate in 10 tagged plants in 250 ml plastic containers filled with 70% ethyl alcohol up to half of its capacity and closed with the lid. After collecting the samples, the labels containing the information about the date of observation and the quadrate from which the samples were collected were written and pasted on the container.

2.1.3. Collection of Thrips Species from Fruits

The thrips species feeding on the chilli fruits were collected by gently tapping ten fruits from each quadrate in zip lock polythene bags and labelled for identification in the lab.

2.2. Separation of Thrips Species from Chilli Plant Samples

2.2.1. Separation of Thrips from Leaves and Flowers

The chilli leaves and flowers collected in 70% ethyl alcohol solution were brought to the Laboratory. To collect the thrips present inside the leaves and flowers, they were transferred to 500 ml beaker separately and to the samples 30% ethyl alcohol was added till they immersed completely and washed 3 to 4 times in 30% ethyl alcohol solution and then the solution was poured in to a big petridish (13 cm) by retaining the sample in the beaker. The thrips were collected from the alcohol solution with the help of pointed tip of pauster pipette fitted with a rubber bulb on the other end to draw the thrips from the alcohol solution into the pipette. The thrips specimens collected in the pipette were transferred into a glass vial (5 cm × 1 cm) containing 70% ethyl alcohol. After collecting the samples, the labels containing the information about the date of observation and the quadrate from which the samples were collected were written and pasted on the container.

2.2.2. Separation of Thrips from Chilli Fruits

The thrips collected in the zip polythene cover from the chilli fruits were brought to the laboratory and kept in the refrigerator at 4°C for 10 min to immobilize them and then transferred to the vials containing 70% ethyl alcohol for identification.

2.3. Preparation of Microscopic Slides of Thrips for Identification

The thrips collected in the 70% ethyl alcohol solution were

mounted on microscopic slides for easy identification of thrips according to the methodology [16].

2.3.1. Preparation of Temporary Slides

The temporary slides though last for lesser period they are useful in quick study of the thrips. Temporary slides were prepared by using lactophenol solution. For preparing the slides the thrips were placed on a clean slide and after arranging all the appendages and wings few drops of lactophenol was added and cover slip was placed gently on the specimen.

2.3.2. Preparation of Permanent Slides

The different steps used for preparation of permanent microscopic slides

(i). Maceration

1. The thrips specimens collected in 70% ethyl alcohol solution were transferred in to a watch glass and to it freshly prepared 60 per cent alcohol was added and stored for at least 24 hours.
2. After 24 hrs it was replaced with 5 per cent NaOH and left for half an hour for pale specimens and for up to 4 hours for larger or darker specimens.
   a. The abdomen was punctured between the hind coxae with a fine needle and subsequently the specimen was gently massaged to expel most of the body contents.
   b. The legs and antennae were spread to make the appendages supple.
3. The NaOH was replaced with a little distilled water and gradually 50 per cent alcohol was added.
4. The 50% alcohol was replaced with fresh 60 per cent alcohol and stored for 24 hours.

(ii). Dehydration

Alcohol and clove oil absorb water from the atmosphere, particularly under warm humid conditions; watch glasses containing these liquids therefore were covered by a closed fitting lid.

1. The 60% alcohol was replaced with 70% alcohol and left for 1hr.
2. The specimens were transferred to 80% alcohol and left for 20 minutes.
3. Later they were transferred to 95% alcohol and left for 10 minutes.
4. The specimens were transferred to absolute alcohol and kept for 5 minutes.
5. It was again replaced with another fresh absolute alcohol and stored for another 5 minutes.
6. Finally after replacing the absolute alcohol clove oil was added and kept for about half an hour before mounting.

(iii). Mounting

For mounting the specimen a drop of canada balsam was placed on to the center of a clean 13mm diameter cover slip and one specimen was placed on the cover slip ventral side uppermost.

1. The legs and wings were spread and the antennae were straightened by pressing on the basal segments with a fine needle.
2. A small drop of balsam was placed in the center of a clean microscope slideand it was inverted and lowered firmly but, gently onto the specimen in balsam on the cover slip.
3. As soon as the surfaces touched, the slide was re-inverted with the cover slip adhering: this technique usually avoids the in advertent introduction of bubbles.
4. The quantity of balsam must be sufficient as after it has dried- to support the cover slip without distorting the specimen. The prepared slides were placed immediately into an oven at about 50°C for 1-2 days until hard, but a few minutes first on a hot plate to drive excess xylene.

(iv). Labelling

An insect specimen is usually of link reference value if it is not labeled with its original data. After removing the slides from the oven they were labeled with appropriate data.

On the right hand label the host plant name followed by the place from which it was collected (in capital letters) the locality and collector's name was written. On the left hand label the genus and species name was written after identifying the specimen with sufficient room left for any special notes to be added about that particular specimen eg. Measurements, number of wing setae etc.

2.4. Identification of Thrips Species

The thrips species were identified by examining their characteristic details and features. The identification of thrips was done using the key developed by Moritz *et al*. (2004). The identified species and slides were sent to Dr. Rama murthy, Faculty of Indian Agricultural Research Institute (IARI) for further confirmation.

3. Results and Discussions

Identification of Thrips Species

The species composition of thrips studied in chilli leaves, flowers and fruits indicated the existence of 5 species of thrips. They are *Scirtothrips dorsalis* (Hood), *Frankliniella schultzei* (Trybom), *Thrips hawaiiensis* (Morgan), and *Thrips palmi* (Karmy) under Terebrantia sub order and *Haplothrips verbasci* (Osborn) of Tubulifera sub order. Among the five species, *S. dorsalis* was the dominant species and this was the only species found in chilli leaves and fruits (Figure 1), where as in chilli flowers *F. schultzei, T. hawaiiensis, T. palmi* and *H. verbasci* were observed (Figure 2). The various morphological and taxonomic characters used for identification of thrips are colour, ocelli, antennae, setal arrangement on fore wings, pronotal setae and abdomen. The identification characters of different thrips species are presented and the diagnostic features of the chilli thrips are described below.

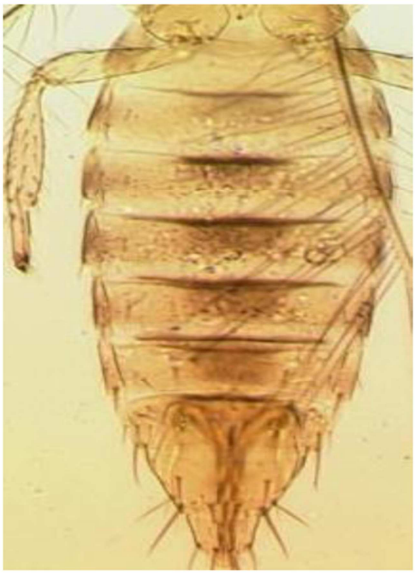
Figure 1. *Scirtothrips dorsalis (Hood), the predominant species occurring on the lesves and fruits.*

Frankliniella schultzei *Thrips palmi* *Thrips hawaiiensis* *Haplothrips verbasci*

Figure 2. *Species diversity of chilli blossom thrips.*

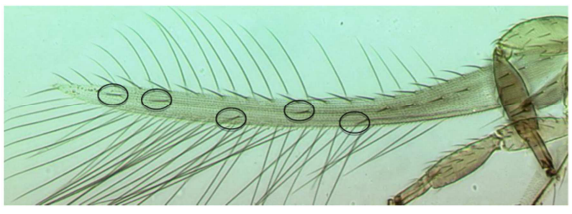
3.1. Scirtothrips Dorsalis

The taxonomic characters used for identification of *S. dorsalis* are colour, costal ridges on abdomen, antennae, ocelli and setae on fore wing. Body colour is pale yellow with dark brown costal ridges on abdominal segments 3-7 (Figure 3 a). On head 3 bright reddish ocelli are present. Pronotum is devoid of setae (Figure 3 b). In fore wing first vein bears 3 closely spaced setae and second vein with 2 setae on distal end (Figure 3 c). Antennae 8 segmented (Figure 3 d). The taxonomic characters identified in the species confirmed the taxonomic key given for *S. dorsalis* [17-19].

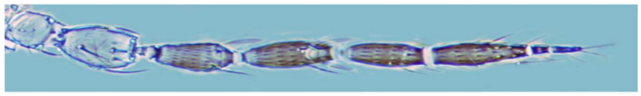


a) Dark brown costal ridges on abdominal segments 3-7]

b) Bright reddish ocelli andpronotum devoid of setae



c) Fore wing first and second veins with 3 and 2 widely spaced distal setae

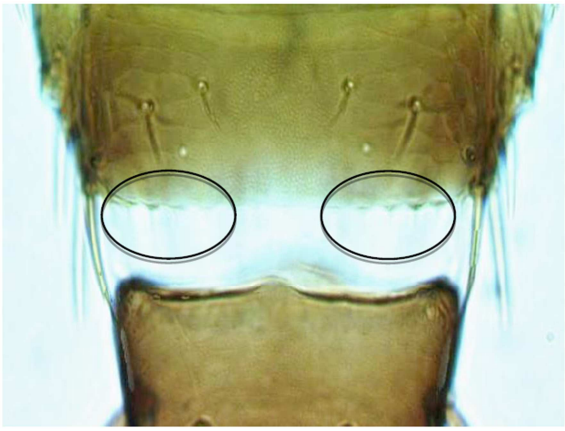


d) Eight segmented antennae

Figure 3. *Taxonomic characters of Scirtothrips dorsalis.*

3.2. Frankliniella Schultzei

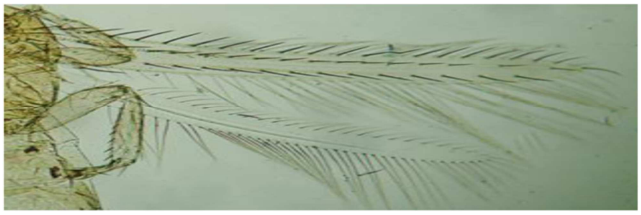
The species identification was based on colour of the body, ocelli, setae on ocelli, pronotal setae, wing venation and comb on 8th abdominal segment. This species lacks distinct comb on 8th tergite of female (Figure 4 a). In the literature though it was mentioned that the colour is variable, ranging from yellow to brown (Mound, 1968), in the present study the species is paler in colour. The three ocelli are light brown in colour. A pair of ocellar setae arising between the post ocellar setae (Figure 4 b). Two pairs of setae are present on both anterio lateral margin and posterio lateral margins of pronotum (Figure 4 c). On the fore wing two rows of continuous setae are present (Figure 4 d). Antennae are 8 segmented (Figure 4 e). Taxonomic characters identified in the species are in accordance with the identification key given for *F. schultzei* [20-22].



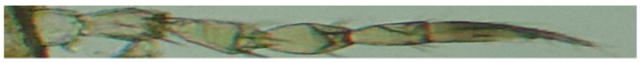
a) Indistinct comb on eighthabdominal tergite

b) A pair of setae arising between the posterior pair of ocelli

c) Two pairs of setae on both anterio lateral and posterio lateral margins of pronotum



d) Fore wing with two rows of continuous setae



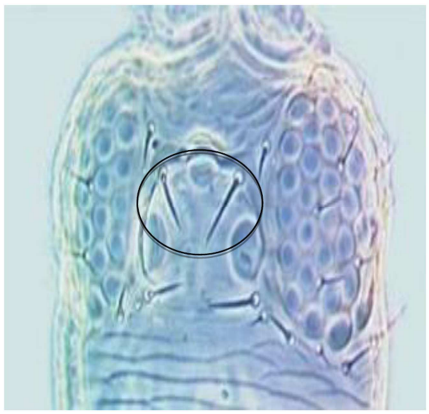
e) 8 segmented antennae

Figure 4. *Taxonomic characters of Frankliniella schultzei.*

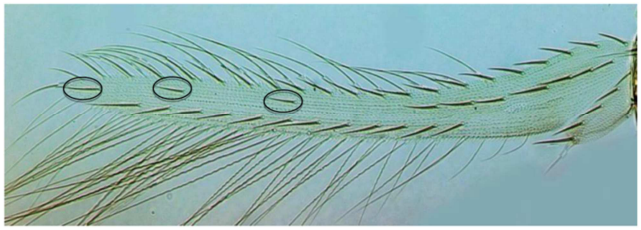
3.3. Thrips Palmi

Thrips palmi was identified based on colour of the body, ocelli, ocellar setae, arrangement of veinal setae on fore wing and posterior marginal comb on 8th abdominal segment. The body is yellow to straw colour with no dark areas on body. Antennae are seven segmented (Figure 5 a). Ocellar setae III standing outside the ocellar triangle (Figure 5 b). Forewings with broken rows of wing vein setae (Figure 5 c). Pronotum consists of 2 pairs of setae on posterio lateral margins and no setae on anterio lateral margins (Figure 5 d). Tergum of 8th abdominal segment with complete comb of fine slender setae (Figure 5 e). The identification characters were confirmed by referring the taxonomic key provided for *T. palmi* [23-25].

a) Antennae 7 segmented

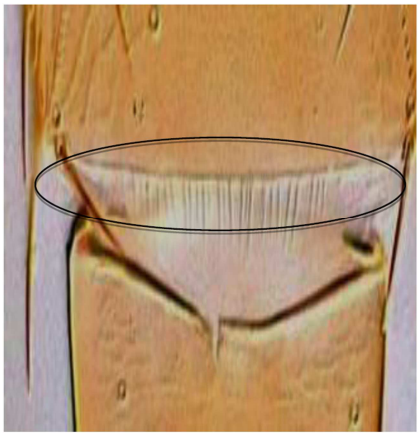


b) Ocelli setae III standing outside the triangle



c) Forewings with broken rows of wing vein setae. First vein with 3 distal setae

d) Pronotum with 2 pairs of setae on ocellar posterio lateral margin



e) Complete comb on eight abdominal segments

Figure 5. *Taxonomic characters of Thrips palmi.*

3.4. Thrips Hawaiiensis

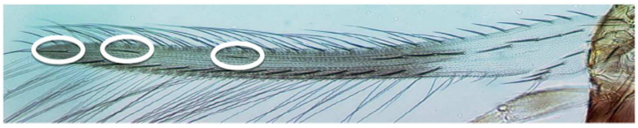
The identification of this species was done based on colour, ocelli, pronotal setae, forewings veinal setae, antennae and ovipositor. It is a dark coloured specimen with brownish abdomen whereas, thorax and head are yellow to orange brown. Ocellar crescent is orange red (Figure 6 a). Antennae 8 segmented, brownish except segment III, which is yellow in colour (Figure 6 b). Pronotum with 2 pairs of posterio lateral setae (Figure 6 c). Ovipositor well developed and serrate (Figure 6 d). Forewing dark in colour except the basal ¼ region which is light in colour, on fore wing discontinuous rows of setae. On the fore wing first vein with 3 distal setae (Figure 6 e). Complete but irregular comb on VIII tergite (Figure 6 f). The identification characters observed in the species were confirmed with the identification key given for *T. hawaiiensis* [26, 27].

a) Orange red ocellar crescents

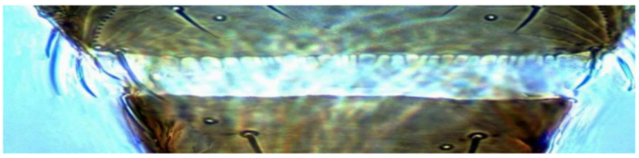
b) Antennae 8 segmented, brownish except segment III

c) Pronotum with 2 pairs of posteriolateral setae

d) Serrated ovipositor



e) Forewing first vein with 3 distal setae



f) Complete but irregular comb on VIII tergite

Figure 6. *Taxonomic characters of Thrips hawaiiensis.*

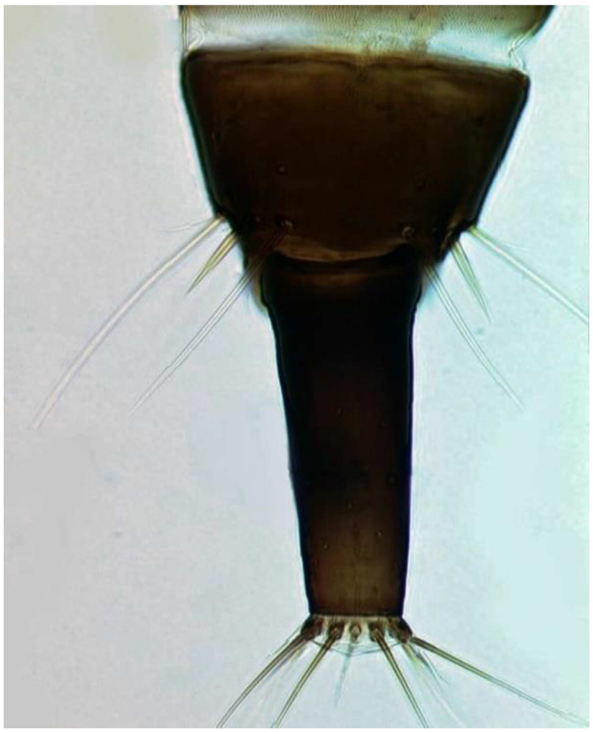
3.5. Haplothrips Verbasci

This species belongs to the family Phlaeothripidae of Tubulifera. The species was identified based on colour, antennae and bases of fore wing sub basal setae and tip of the abdominal tube. The body and legs are dark brown in colour. Antennae 8 segmented, antennal segments I, II, VII and VIII dark brown and rest of the segments are light in colour (Figure 7 a). Fore wing pale, major setae dark brown. Fore wing constricted medially, sub basal setae on fore wing arranged in a line (SBL) (Figure 7 b). Tip of the abdomen is tubular and long (Figure 7 c). The descriptive characters identified in specimens are in conformity with the key characters given by [28, 29]. The arrangement of bases of fore wing sub basal setae in a triangle (SBT) or in a line (SBL) is one of the taxonomic characters in species level

identification of the genus Haplothrips [28]. In the present study the fore wing basal setae arranged in a line as observed in *H. verbasci* confirms the identification characters given for *H. verbasci* by Mirab-balou *et al*., (2012) [28].

a) Antennae 8 segmented, antennal segments I, II, VII and VIII dark brown and rest of the segments are light in colour

b) Fore wing constricted medially, sub basal setae (SBL) arranged in a line



c) Tubular abdominal segment

Figure 7. *Taxonomic characters of Haplothrips verbasci.*

Leaves

The thrips species collected and identified from chilli leaves at weekly intervals throughout the crop growth period (Table 1) indicated that among the 1000 specimens observed in the laboratory, all the specimens were found to be *S. dorsalis*. No other thrips species were observed in the young terminals. The feeding damage by *S. dorsalis* on young leaves resulted in severe reduction in leaf size and later caused upward curling of leaves.

The*S. dorsalis w*as the serious pest of chillies and other hosts [30]. The presence of *S. dorsalis* on chill leaves in India was first noted by Ramakrishna Ayyar in Coimbatore as early as in 1916 [31]. The results are also in agreement with the findings of [32, 33] (1979) and they reported *S. dorsalis* as the important sucking pest of chillies. Jaganmohan *et al*., (1980) [34] observed *S. dorsalis* as the serious pest on sweet pepper leaves. The*S. dorsalis* sucks the sap from tender portions of leaves, causing shrivelling, puckering and upward curling of leaves [35].

The nymphs and adults of *S. dorsalis* suck the sap from leaves causing upward curling of leaves and reduction in leaf size in pepper [36]. The conducted experiments on distribution of chillithrips, *S. dorsalis* in pepper stated that adults and nymphs were more abundant on top leaves of pepper [37]. *S. dorsalis* damage results in feeding scars, distortion of leaves and discolouration of buds by feeding on the meristems of the host plants terminals and other tender parts of pepper [38]. The *S. dorsalis*was the predominant species which occurred in large numbers (9.33/leaf) on chilli [39]. Field experiments to study the pest complex of capsicum in Bangalore conditions of Karnataka, India during 2012-13 showed that*S. dorsalis* as the predominant species on the leaves [40].

Flowers

To study the species composition of thrips in chilli flowers, 667 thrips specimens collected from the flowers were identified in the laboratory (Table 1). From the flowers four species of thrips were recorded. Among the 4 blossom thrips, *F. schultzei* was the predominant species accounting for 84.40% of the total blossom thrips population followed by *H. verbasci* which constituted 10.80% of the total blossom thrips and *T. hawaiiensis* accounting for 4.20%. *T. palmi* was found in very low numbers (4) contributing to 0.60% of the total population (Figure 8). The flower thrips belonging to the genus *Frankliniella* often colonized their host plants in large numbers during the flowering stage [41]. The present findings are in agreement with the reports of [42, 43] and they found *F. schultzei* in flowers of pepper and cowpea, respectively. The presence of *F. schultzei* on chillies also reported [44]. Studies on the diversity of thrips species in leaves and flowers of chilli plantation in the region of Jambi were conducted during June 2012 and the results showed the occurrence of seven species of thrips. Among them *T. parvispinus, T. palmi, T. coloratus, Ceratothripoides brunneus, T. setosus* and *T. hawaiiensis* were observed in very low numbers, while *T. coloratus* and unknown thrips belonging to the sub order Tubulifera was found in moderate numbers [15]. The*T. palmi* were more abundant in pepper flowers [45]. *H. verbasci* and *T. hawaiiensis* identified in the present study in chilli flowers was the first report from India. In the literature though *H. verbasci* was not reported from chilli, it was recorded from the flowers of *Verbascum thapsus* from western Iran and also in the flowers of Asteraceae and Poaceae [29].

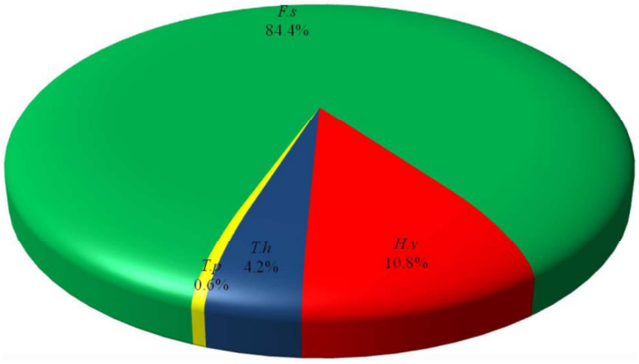


Figure 8. *Species composition of blossom thrips in chilli.*

F.s = Frankliniella schultzei, H. v = Haplothrips verbasci, T. h =Thrips hawaiiensis and T. p = Thrips palmi

Fruits

To assess the species composition of thrips in chilli fruits, 655 thrips collected from chilli fruits were identified. The results (Table 1) showed the presence of only one species of thrips feeding on chilli fruits *i.e. S. dorsalis*. The feeding damage by *S. dorsalis* on fruits resulted in scarification of fruits. On the fruits more number of larvae were observed compared to the adults. None of the thrips species recorded in the chilli flowers were found on chilli fruits. From the results it was evident that *S. dorsalis* was the dominant species infesting both leaves and fruits. The results are in accordance with the findings of Seal *et al*., (2006) [37] who found the occurrence of*S. dorsalis* adults and larvae on chilli fruits and they reported that thrips feeding damage resulted in development of corky tissues on infested fruits.

The species composition studies of insect pests of chilli, *S. dorsalis* as the predominant species in both leaves and pods [46]. Damage by*S. dorsalis* in pepper fruits caused fruit distortion and fruit discolouration [47]. In contrast to the present findings [48] reported the occurrence of 4 species of thrips on fruits of field pepper and they included eastern flower thrips (*F. tritici*), Florida flower thrips (*F. bispinosa*), western flower thrips (*F. occidentalis*) and melon thrips (*T. palmi*). The species variation of thrips observed in chilli from different parts of the world could be attributed to the abundance of resources and geographical conditions or density dependent factors [49]. The damage caused by *S. dorsalis*nymphs and adults on Pomegranate fruits by lacerating and sucking the fruits which resulted in shrivelling of fruits, scarring of rind was also observed on fruits due to desapping, resulting in decreased marketability of fruits [50]. Kumar *et al*., (2009) reported the damage symptoms on pepper fruits due to *S. dorsalis* which caused grey to black markings on fruits often forming a conspicuous ring of scarred tissue around the apex.

Table 1. *Species composition of thrips in chilli crop.*

Plant parts from which thrips were collected	Total no. of specimens identified	Species composition of thrips									
		Scirtothrips dorsalis		*Frankliniella schultzei*		*Haplothrips verbasci*		*Thrips hawaiiensis*		*Thrips palmi*	
		No.	%	No.	%	No.	%	No.	%	No.	%
Leaves	1000	1000	100	0	0	0.00	0	0	0.00	0	0.00
Flowers	667	0	0.00	563	84.41	72	10.80	28	4.20	4	0.60
Fruits	655	655	100	0	0.00	0	0.00	0	0.00	0	0.00

4. Conclusions

The chilli thrips inhabiting the leaves, flowers and fruits were collected and identified in the laboratory using the taxonomic keys. The various characters used in the identification of thrips species included colour of the body, antennae, setal arrangement on pronotum, wing venation and abdomen. The studies revealed that all the thrips specimens identified in the leaves (1000) and fruits (657) contained only *S. dorsalis* and thus *S. dorsalis* was considered as the only species inhabiting both leaves and fruits. From the flowers four species of thrips, 3 belonging to the family Thripidae of Terebrantia sub order and one species from Tubulifera sub order of the family phlaeothripidae were identified. The three species identified under Thripidae were *F. schultzei*, *T. palmi* and *T. hawaiiensis*. The fourth species of *H. Verbasci*belongs to the sub order Tubulifera of phlaeothripidae. Among the 4 blossom thrips, *F. schultzei* was the dominant species and constituted 84.40% of the total population followed by*H. verbasci* with 10.80% and *T. hawaiiensis* accounting for only 4.20% of the total population. Among the blossom thrips *T. palmi* was the least dominant species which constituted 0.60% of the total population and only four *T. palmi* adults were recorded from the flowers during the entire crop growth period.

Based on the results obtained from the study, the following conclusions were drawn.

1. Species diversity studies of thrips inhabiting the leaves, flowers and fruits revealed the existence of *S. dorsalis* on leaves and fruits. From the flowers 3 species *viz*., *F. schultzei, T. hawaiiensis* and *T. palmi* belonging to the Terebrantia sub order of Thripidae and one species, *H. verbasci* from Tubulifera of phlaeothripidae were identified.
2. Among the blossom thrips *F. schultzei* was dominant species accounting for 84.40% of the total population, while the other blossom thrips *viz*., *H. verbasci*, *T. hawaiiensis* and *T. palmi* constituted 10.80%, 4.20% and 0.60% of total population.

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